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SCIENTIFIC TRACTS,

FOR THE

DIFFUSION OF USEFUL KNOWLEDGE,

FURNISHED BY

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THE PHILOSOPHY OF SELF-EDUCATION.

BY B. B. THATCHER.

This is an age of associations. Almost every new enterprise, in whatever department, is carried through, or at least attempted, by a party, or a society, or a corporation, or an association under some other form and name. If a course of lectures is to be delivered, or a canal to be dug, —if an India-rubber factory is to be put up, or a vice or abuse in the community to be put down,—the first movement, infallibly, is to call a meeting, and the second, to organize an institution, for the purpose. Combination is a characteristic of the age; and it is so in our own country more than in any other, by far. We are a people involved in the meshes of all sorts of associations, year in and year out. They scarcely leave us the liberty of *breathing*, without some society's vote, certified by the secretary thereof.

To a certain extent, this general state of things is necessarily the result and accompaniment of civilization. Men are gregarious in all conditions; in a condition of civilization more so than in barbarous communities; variously so in various civilized communities, according to circumstances innumerable; but of all others, most likely to be so, and likely to be most so, in precisely a country and a state of society like our own. The circumstances that produce this tendency need not be here detailed.

Enough for our present argument, that the effect, and the fact, are as they are; that the spirit of the age is essentially and eminently a public spirit,—a spirit of enterprise, and combined enterprise,—a merging, in other words, of individuality in the social principle, (as ice is wasted away in a warm air;) and that the spirit of our country, for permanent reasons peculiar to itself, is the foremost representative and leader of the spirit of the age.

Great good results from this tendency; not great achievements only—moral and physical—beyond the reach of individual resources,—but great good. In this country, especially, as it is one of the consequences, so is it one of the causes,—one of the chief ones,—of our unexampled prosperity. Our associations, great and small—in every department of society and life—from the Federal Union down to the least of all the organized operations of the bodies of men it includes—have carried everything before them. The world never has witnessed before such a development of the social power. But with the great things and good things which have resulted from its action—and still result—and still will—evil also, great evil, has been and will be mixed. Some of it is inevitable, and some of it incidental and needless, while yet another portion perhaps lies between these two classes. It is not wholly to be either prevented or remedied, but is greater than it need be. It admits of being guarded against to a certain extent; and for that reason, if for no other, it should be well understood.

We have alluded already to the amalgamating process in character (so to speak) which, under these influences, is going on among us; and that is the result we now particularly refer to as one to be kept in mind. It is the melting down of individuality in the floating character of the ambient community, and in the warm incumbent

atmosphere of the age. There is danger that the enterprise of the age may be too high for its reflection; it should be a heavy ballast, and a sound hulk, to sustain such a breeze in the straining sails. There is danger that the mind which is vested in its enterprise is but too much taken *from* its reflection. There is danger that matter will occupy us disproportionately more than mind itself,—it is a material, a mechanical, a money-making, as well as a social age; danger, that things, disproportionately more than men, will absorb our attention and our action; greater danger still,—the greatest of all,—that of the men and of the mind, which do occupy us, far too large a portion, for our best good, will be other men, and other mind, to the exclusion and disparagement of ourselves, and of our own. It is more than danger. It is danger realized in injury, and fast being more so. The evil incident is becoming, almost as much as the great characteristic cause we have mentioned, one of the features of the country and the times.

Education is one of the grand investments of the reflection we have spoken of. The education of a generation of men best represents, on the whole, in the true sense of the words, the amount and quality of its reflection. In this department we may expect to see the surest and strongest manifestation of it, or of the want of it, or of its abuses. The education of the body politic is, as it were, its blood, and in it are sure to be seen, and to be shown, as by a thermometer, all the material changes which affect the system. This is, in one sense, eminently an age—*the* age—of Education. The enterprise of the age is displayed in nothing more than in its ostensible education. In our own country, again, this is especially the case. We have not pushed our canals and railroads with a more prodigious energy or a more subtle

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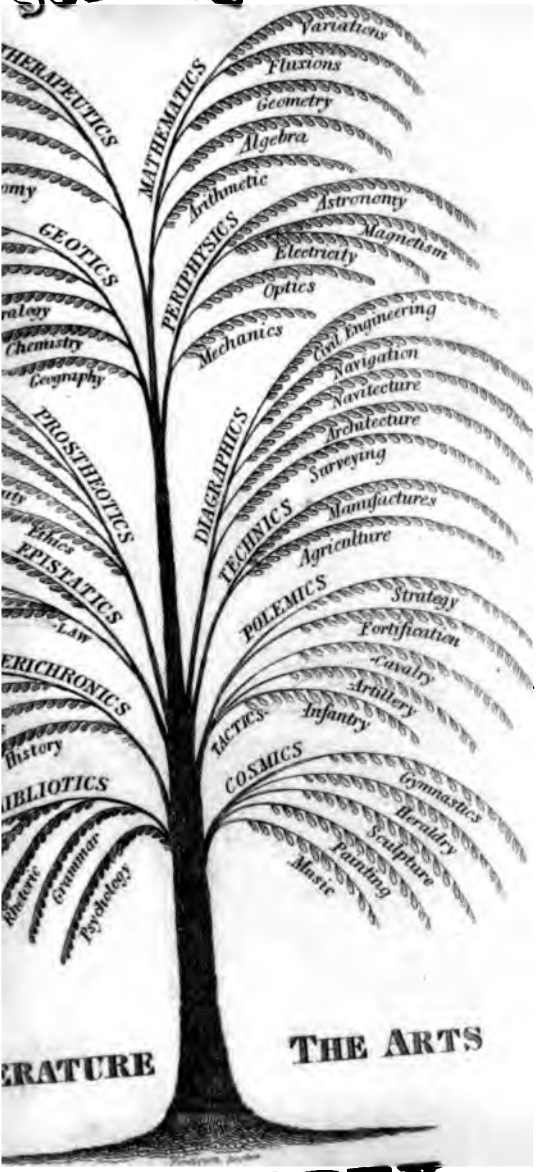

PHILOSOPHY.

for the great general object of the physical, intellectual and spiritual improvement of the People and of the Race. Education, we say, is the essence of them all, or is meant to be. It is the sublime aim of this magnificent philosophy that every living mind shall be supplied. It is meant that no poverty, no infirmity, no disinclination, no crime, vice or fault, no disaster or distance, no mere circumstance, in fine, of any sort, shall stand in the way of the universal application of the scheme. It runs like a railroad, with branches to every by-place on the way. It goes under mountains, and over rivers and swamps. It takes on everybody and everything, at some rate or other. It is the Railroad of the Reason of the age.—It is the age of Education.

Of this, itself, of course, we do not complain. We do not complain of the effort, or of the enterprize, which goes into any moral, as distinguished from any material use. It is so much saved, at least, from augmenting the tide of the tendencies of the age we have spoken of; perhaps so much added to the force which must be relied on to counteract them. We wish, however, it were more than it is. We wish it were all even that it seems to be. We wish the real result were in proportion to the real effort, or the substance in proportion to the show. It is greatly to be feared, not to say apparent on the face of everything, that it is not so; that the character of the times, in regard to its objectionable traits, as well as its good ones, enters into its moral as much as its material operations, and into *this* as much as any other; that velocity, more than thoroughness, to display more than to do, and to do more than to be, especially, are but too much its growing traits; that, as we said of the age at large, it is true of its action in this field, that its reflection is not adequate to its enterprise. In a word, a great deal too much of what

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is meant to be education, is no education at all, or little better than none: the arrow falls short of the mark. A great deal more of it is the least substantial part of it, though at the same time often the most available, as circumstances are, and in nothing more so than in being the most showy. It is not all gold that glitters, however. The tin in the farmer's cornfield makes a greater show than the diamond in his daughter's ring; and so do the gewgaws which the Indian swings in his ears.

It amounts to this. We have compared the education-enterprise of our day to the railroad of the same. It is not a mere simile. There is too much of the railroad principle, and especially of the high-pressure system, in the scheme. There is much more than the subject will bear; for as there is, according to the old saying, no royal road to learning, so there is no railroad to it,—to education,—to self-education, much less. The vital principle of all these, amid all the countless changes of the times, remains the same, and it never can be altered. This is a principle of the mind,—a principle of man,—and mind and man remain and must remain the same. We have made so much of an enterprise of education that we have forgotten to make it a discipline. We have merged the individual interest in the copartnership concern. We have tried all sorts of education but self-education. We have educated everybody but ourselves.

Of course, we use this much abused word in its thorough and true sense. More or less educated we all are. All civilized nations are. All mankind is, and always was, and will be. They are a law unto themselves. They are educated more or less by the inanimate and the animate nature, and especially by the human nature, and by all the circumstances of their condition, whatever it is, which surround them. There is a principle in them

all,—in man's mind,—(the principle alluded to already,)—which enables, and stimulates, and compels them to be so; a principle which enables them in a certain degree to dispense with the materials and the motives that even civilization and christianity suggest and supply; a principle without which, in the midst of all these means, any man—any mind,—if without it they could be imagined to exist and to remain *such*,—must be as insensible to their influences, and as incapable of improvement from them, as though the body and soul were cased alike in coats of solid steel.

The savage is educated. He educates himself. He avails himself of his circumstances, such as they are, and prepares himself for his condition, such as it may be. He makes himself a good warrior and a good hunter. He trains his mind in many things, and his body in almost all. His eye is keener, and his ear more sensitive, and his feet fleeter, and his whole system more enduring, and available,—more self-possessed—more educated,—than those of most men more civilized than himself.

Franklin tells a story of some Pennsylvanian chieftains who met a deputation of the old settlers of that state, at Lancaster, in ancient times. When the business of the council was settled amicably, the latter, by way of compliment or conciliation, offered to take some of their sons, and *educate* them; meaning, perhaps, to put them to school, or to college, or both; to make scholars and gentlemen of them, in the white sense. The red men listened in solemn silence, and took the matter into grave consideration, as usual, and replied:—"Brothers! we are much obliged to you for your offer to take some of our papooses, and *educate* them. We presume you mean well by that,—that you mean to do them and us some

good. We think, however, that they had better stay with us. We understand hunting, and fishing, and fighting, better than you do. We can teach them better. Brothers! we will keep them and educate them ourselves!"

The Indians, in one sense, were right. Every man should be educated for what his condition is to be. He is best educated when he is best fitted for that condition. If the young men were destined to live in the woods, there was the school for them to learn in.

So in civilized countries, of course, to some extent. We said, more or less educated we all are. It is impossible, in the nature of things, that any mind should exist anywhere without being educated, and without educating itself, in some way or degree,—artificially or naturally, well or ill, as the case may be. In a country like ours, and a period like this, it is most impossible of all. We cannot avoid breathing in, from our birth, the atmosphere of the age. It circulates through us, as the common air does through the lungs, whether we will or no, and whether we sleep or wake. We must take it, however, as it comes, and make the best of it. If we breathe in the good elements, we are exposed also to the evil. Association, habit, sympathy, excitement, example, may insensibly instil some of the exceptionable influences into us. Our rail-cars go both ways, and about as fast one way as the other,—and the steam which propels either way is the same. If we are more or less better and wiser, therefore, as it is to be hoped and believed we are a good deal, for living when and where we do, than we should have been had our lot fallen among the Calmucks, or in the dark ages,—better and wiser for being surrounded and supplied by the vigorous and the virtuous elements of the spirit of

this generation,—it would be strange indeed, on the same principle, if we did not participate, all of us, in its deficiencies and its faults. It is a country and a period of prodigious energy, enterprise, emulation, excitement of all sorts; and of occasions and opportunities for all, inexhaustible, in proportion. There must be impetuosity, irregularity, rashness, recklessness, hurry, in the process. There must be artificial and superficial character, and all the marks of haste and heat, in the result. Especially must there be too much dependence upon the social principle, and too little upon the principle we have spoken of,—the centripetal,—within. Of this, of its operation, and particularly of the necessity and benefit of its culture, we come now to speak more in detail.

We shall call it *the principle of self-education.* To define it, like defining any other mental principle, is not so easy a matter, perhaps, as to describe it, or to describe its results. We may venture to say, however, that it is, in other words, *the principle of making the most and the best of one's self.*

This, of course, implies a good deal. The man who possesses and cultivates such a principle in perfection, is or becomes, humanly speaking, a perfect man. The more he does so, the more perfect he is and becomes. It includes all the policy of reason, and all the philosophy of religion; and it implies the result of the exercise of both.

It implies the science of self-knowledge. No man can make the best or most of himself, who does not understand himself. If he ever does so, it is only by accident; and of the two, he will be much more likely to blunder in the other way. Every man to his trade, is an old saying, and a good one. A poor shoemaker will generally make, nevertheless, a better pair of shoes than a good tailor, or a good blacksmith, (unless they be cloth ones, or for the

use of a horse; and there the principle is the same.) We must know the means we have to work with, and the use of them. So we must know our own mind. This, with the body, is a set of instruments common to the race. It is the best one ever made. It is the only one which we cannot do without. The diversities in it, and in its use, constitute or cause all the essential diversities in the career and character of men. If we are all alike in mind originally, then the diversity in the result depends solely on the use,—and one man, to all substantial purposes, may be a Bonaparte or a Newton, about as well as another. If we are different, and of course some of us inferior, so much the more indispensable is it for us to find out what we can depend upon, and what we can do or be, to the best advantage, and to act accordingly; so much the more important, that is, to make the most of what little we have. We must understand ourselves, then, at all events; the more, the better. This implies effort. Self-knowledge implies self-study,—the hardest study of all,—the least attended to in the schools,—the most needed among men.

It is the more so, and the more useful in every way, inasmuch as other men are essentially like ourselves. The world is made up of substantially such people as we are. We differ in detail, to be sure. However it is at the outset, other circumstances, if not constitution, modify us in infinite varieties of ways, till our minds get to differ as much as our bodies, at least. Yet, in the main, we are the same. Writhe as we will in the several situations allotted us, high or low, good or bad, and disguise the commonplace truth as we may, we are all human, and no more nor less, still. We are wrought upon by like influences, and we work with the same means.

To know ourselves, therefore, implies knowing something of others. It implies, to a very considerable and a very available extent, what is called the knowledge of human nature, (which is of course our own nature,) and the knowledge of the world, (which is an aggregate of individuals like ourselves.) How useful this is, we need not say. We cannot make the best of ourselves, without making the best of other people, and of the world. We all work with each other, and upon each other; we are all wrought upon, also, by each other. We must do so, and we must be so, so long as we remain men, and among men. Our education itself, to no small extent, must doubtless be got by this kind of exercise, and this kind of impressions. It is thus that we develope ourselves, our faculties, whether passive or active, of feeling and thinking, of scheming and putting in practice, of body and mind.

A great part, we say, of the process of every man's education, consists in this action and reaction. A great part of the difference between different men, so far as education goes, is in the difference of their appreciation and their appropriation of this branch of it. If they appreciate themselves well, they will appreciate this, and profit by it. If they do not, they will suffer in proportion. They will not only lose the disciplinary benefit derivable from the social world they live in,—that benefit which an understanding and a constant bearing-in-mind of human nature and of their own, will give them, and which nothing else can,—but they will be the sport, the creature, the slave, the prey of mere influences, so far as their intercourse with the world goes. Their characters will be made up of layers, as it were, of such influences, good or bad, more or less, as the case may be. They will be all the result of accretion; all alluvial. The

world is full of such men. It is more proper to say they have no *characters* at all. Character implies activity, independence, self-dependence, self-control. Theirs is but a specimen of what a man may become without these all. It is a sort of consistency of impressions.

A man should study himself, then, that he may know himself, and that he may understand human nature, and that he may avail himself *of* himself, and of other men, to the best advantage. This system will lead him, in course, to a direct study also of others, and of the world,—as, for example, in every instance of the intelligent and voluntary exercise of his influence upon them, or of theirs upon himself. The study of himself and of them, if he goes to work scientifically, will proceed hand in hand. Some men study the world too much, and themselves too little. Others study books almost exclusively, to the neglect of both. Another class study things,—*other* things,—perhaps business,—perhaps something else. The great mass, it is to be feared, study not at all. The remedy for each deficiency,—the right system for every man,—would be, we say, to study himself chiefly and first. This would lead him, if he followed it out, to all the other knowledge of men and of the world, not to say to all knowledge of everything, which he wants. Our age has reversed this order. They attend to everybody and everything but themselves. They make themselves the means, instead of the end. Instead of being, and then doing, they want to do without being. Doing is but the shadow, the shadowing-forth, of being; and they grasp, in their eagerness, at the shadow,—like Æsop's dog crossing the river, with the meat in his mouth,—and lose all.

The general neglect of self-study seems the more unreasonable when we consider, as we are perhaps not very apt to do, that, in some sense, we can depend upon

nobody, and upon nothing, scarcely as well as upon ourselves. Our facilities, as they are commonly called,—our facilities of education, in the liberal and general sense of the term,—our external circumstances of every sort,—(it is no new saying),—are little to be relied on, either to remain with us, or to render us any service. These circumstances are changing every moment while we stand in the midst of them. A breath may cast a shadow over them, as it does on the face of the mirror. The slightest jar, as it were, may jostle them, like the beads of the kaleidoscope, and bring up, as that does, a combination and an aspect totally different from the last.

All external circumstances, like riches, take to themselves wings, and fly away. Man only remains,—the nucleus for continual successions of changes. He should remain the same. He should retain the continuity of his character through all. He should cherish the intrinsic vitality of principle which no circumstances can either give or take away, and which, instead of depending on them, will compel them, as they make their appearance, and pass through all their changes, to be serviceable to himself; to adapt themselves to his mind, according to its principles, instead of their own; to crystallize around it in shapes of beautiful and radiant symmetry, instead of smothering it in mere conglomerations of accidents.

It should be thus, we say. It may be with every mind. It is its own fault, intellectually, if it is not. In the midst of all these uncertainties which surround us, there is almost a comfort, and there is clearly an advantage, in knowing and bearing in mind, that all things *are* uncertain;—all things but the principle we bear within us. This is a certainty, if we make it so. If not, we have no anchor at all, and we must be driven to and fro

by every wind that blows. Let us hold fast then by ourselves. Let us keep ourselves our own property, and in our own possession, and in good repair. Then circumstances may "be added unto us," or not. If they are, we shall have the power of making the best of them. If they are not, we can make the best of ourselves without them. We shall live, and thrive, in either case. That is the result of self-education.

We have detailed, to some extent, what this process implies. It is obvious, farther, that it implies everything which education does. The principle of self-education applies to all the materiel out of which all education is derived. It includes the appropriate use, to this end, of all the opportunities, facilities, faculties, available to the improvement of a man, according to his situation. This, we need not say, is a good deal. In this sense,—that is, to this extent,—no man is or ever was educated, by himself, or otherwise. It is true, *there never lived an educated or a self-educated man.* It is probably impossible for us, from the want of anything like even an instance of exemplification, to conceive what such a being would be. We do not yet sufficiently know, by trial or in theory, what *are*, even, the real powers of man—of body or mind—to form such a conception, in any adequate degree, of what they may be made, and what they might accomplish. That spectacle is reserved, we trust, for some future, more fortunate age,—an educated human creature,—self-educated of course, he must be,—*a model of a man.*

If all this be implied, as it evidently is, by our definition, we need scarcely allude more particularly than we have done, to the deficiencies, and inconsistencies, and various abuses of the various systems of education, (so called,) or processes without system, which, in this and all other civilized countries, have usurped, and do still

usurp, so extensively, the guise of that great end of civilization—of society—of life itself. We will not undertake to say that none of them are good; and still less, that none of them are good as far as they go. No one probably will deny that, on the other hand, many, not to say most of them, are not so; neither good so far as they go, nor good at all; perhaps not preferable, (as they are sometimes said to be, for a sort of dismal consolation, by those who perceive their faults,)—not preferable even to no education, or no attempt to give or to get one, at all. Their effect, so far as they have one, is to put the mind out of proportion and out of order, which, without them, would at least be more likely to remain *in*, as the Creator made it. They work upon the mind generally, and in the aggregate, as certain parts of them, or certain other processes or practices of modes or systems of education, work upon the body of the patient who is unfortunate enough to be exposed to the pressure of *their* screws. They do not neglect simply, but distort and deform. They cannot neglect indeed without such consequences. They cannot pretend, or undertake, as they do, to draw out one faculty, or set of faculties, exclusively, or principally, or disproportionately in any degree, without producing some kind and degree of moral and mental deformity and distortion.

It is manifestly, in fact, a law of our nature,—as manifestly reason must anticipate, on the least reflection, that it would be,—that the whole of it is made to be used, and to be made the most and best of; all the moral powers, for example, as much as all the mental; all the physical, we need not say, as the indispensable means, at least, of carrying on all the others to the best or to any advantage; all the spiritual, most of all, as the highest part of man's immaterial and immortal nature,—the aspirations and

attributes that link him closest and raise him nearest to the Divine Mind itself, which is the origin and fountain of his own. According to this law, and to all laws of nature—of all nature—it must necessarily be supposed not only unconstitutional (so to speak) in theory, and more or less prejudicial in fact, to attempt, as most processes of education do, and always have, a system of what we may call favoritism with the faculties of man—but it must be supposed absolutely impossible, by such a system, to draw out any of those faculties, even the favorites themselves, to the best advantage, or to the extent of which they are intended to be, and are intrinsically, capable. Such a system, in other words, is impracticable. It cannot be successful according to its own theory of success. It cannot succeed, and does not, in the legitimate, constitutional development of any portion or portions of the nature it tampers with, any more than of the whole, as a whole. It succeeds only in preventing such a development, itself, and in standing in the way of any other system which might secure or promote it. All the physiology of the body, and all the philosophy of the mind, are pledged against it. These go hand in hand, and they both require, as a first principle, that not the whole mind only, or the whole body only, but that the whole man, should be the object of the operation, and that the operation should be applied, and the application pursued, accordingly. Just so far as it is not, just so far it must fail, even of its own end; still more, of the true end of education. It may seem to develope, in a certain degree,—and so it will;—but it developes one thing both imperfectly and to the disparagement of another and of all. It stuffs one member of the family of faculties, to starve another. The surfeit is injurious to one, and the

deficiency to the other. The system, as such, is fatal to the whole.

We cannot pursue the philosophy of this subject into the minutiæ which would best illustrate what we mean. Almost every one, however, who pretends to have studied the character of our common-school and other general, perhaps universal, republican routine in the *literary* and public part of the education of youth, must acknowledge an almost equally universal and equally unrepublican, (as well as unphilosophical and unpractical,) comparative neglect of that kind and degree of *moral* discipline which ought always to go both before it and near it, as closely and constantly followed up by it as the substance, in the sunshine, is by the shadow. The literary ought to be subservient to the moral, in such a sense. It ought to be acquired, and used, as a moral means, among others. Our systems too generally more than reverse this order. They scarcely admit the moral to the place of the shadow. They do not allow it to be the servant, much less a co-partner, of the concern. They do not recognize it at all. They leave it to shift for itself; and it does so. It is no merit of this part of education, therefore, if it still lives, and flourishes. It is the merit of some *other*, or of the self-preserving instinct,—the instinct of self-education, operating in this neglected field,—the instinct of making the most and the best of *itself*. With all our excellent moral institutions, the morality of this country has a great deal to do for itself. It would not need so many of *them* as it does, if literary education were directed more to its benefit than it is. It would not need them later so much, if it had them earlier. It would not require cure, much less punishment, if it had prevention. All society, all civilization, would feel, as much as the man himself, the difference. Society is made up of men, and

civilization is the result of their common character. We should have more and better morality in that society, and in that civilization, of course, as well as in that man. We should have not only him, with his influence, but all other individuals, with theirs. It would be no such distinction as it is now, and always has been, from the days of Aristides "the Just," (as well as before his days,) to point out a member of society as a moral man, or a good man, or as a man of feeling and virtue in proportion to his mind; but the distinction would be the reverse. It is the fault of education, we say, and of all the several parts and processes of education, each in its way and degree, that it is not so now. Every mind is made capable of being, in this respect, what some minds are; every character, the same. It is the fault of education, humanly speaking,—that is, it is the effect of the want of it,—that society is not made up of moral men. Every man ought to be an Aristides. His Maker intended and required him to be so. All society, we repeat, all civilization, (more or less,) of which he is one vital part, though a small one,—as well as the whole of his own nature, of which his *morale* is such a part,—feels the wound when he fails to be so.

So of the physical department. Few will deny that this also is most grossly neglected, or otherwise abused. We do not refer only to the physical abuses of society at large, such as the outrages incident in some countries to the factory-system, for instance, or the general condition, indeed, of all the lower classes, as they are called. We refer to all classes, and all countries, though especially to our own. We refer still more particularly,—as a better illustration of our meaning,—to the neglect of physical education, or even physical preservation, in our general American system of literary as well as other education.

In the schools it is most observable, in every grade of them, and in all literary institutions, with very few exceptions, more or less. The body is neglected, if not positively abused, and that to an extent incurable, and essentially fatal, sooner or later,—at least prejudicial,—to the mind, and to the morality, as well as to itself. That is the period when it is most tender and sensitive. An injury then received is never wiped out; and it spreads through the texture of the whole constitution, as ink spreads upon porous paper. To a vast extent,—almost incredible, if stated as facts prove it to be,—deformity and disease, in their recognized shapes, directly ensue. To a still greater extent,—unrecognized—unrecorded, of course,—ensue debility, degeneracy of every sort, liability to evils not yet developed,—the condition of constitution, of mind and body both, which exposes, induces, aggravates, if it does not create. The effect of this again, on mind and morality, as well as upon mere health, and strength, and life,—the effect on society and on civilization,—is incalculable—awful to be thought of.

Here too, as before, we see what we ought to be. We have just instances enough among us of a right physical education,—physical self-education,—just exceptions enough to the general waste or wreck of constitutions, more or less,—to be able to comprehend what we lose. We see here and there a sound body, and a strong one,—apparently so, or very much so, at least,—a comparatively perfect physical condition. In savage communities, there are more of such cases. The Indians, for example, of this country, are more perfect, physically, than we are. We will not here say why they are; enough that such is the fact,—enough that they are physically better educated. They educate their bodies better, as we have remarked once before. We see similar instances, to a certain ex-

tent, in the case of blind men, among ourselves. They generally cultivate the senses which they have, much more than other men. They are compelled to do so, and feel the benefit of that compulsion. But why should not others, as well as blind men, or as well as savages, cultivate all the senses, to the extent they do? Why not cultivate the whole body, and all its faculties, as well? Why wait to be compelled? Why lose the use of such or any advantages, through mere neglect? Why not make the most and the best of the whole man, as well as of any part of him? Why not of these parts, as well as of any others? Why not, in a word, in this department, as in others, pursue the philosophy of self-education,—of making the best, and the most, of *ourselves?* Then, as in the other case, we should all be what a few of us are. We should be altogether what those few, rather, are in some small degree. A new and vast infusion of sound mind,—such as only a sound body can nourish,—would be poured into the whole civilization and christianity of the age and of all ages. Invalids, imbeciles, infidels, would, in a good degree, disappear, all on the same principle. The cultivation of body, of mind, of morality, the cultivation of the physical, mental, spiritual faculties, severally, would thin their ranks. To a very great extent, they are all of them the result and the proof of a want of right self-education, or education of any kind. They are significant of a diseased body-politic. The reform which shall heal them must be a reform, and a radical one, of the whole of that body. It must be the philosophy of self-education, applied to each member of it, and to the whole.

Of such a process, the mere literary portion is evidently the most insignificant, though much, very much, is to be derived from books, schools, and most of the whole regular routine of what is commonly considered "an education,"

as the phrase is;—a "liberal" one, for example. The use or abuse of these,—the kind and quantity of benefit they *may* furnish,—how far they are indispensable, how far desirable, how far serviceable according to circumstances,—are questions, that, with many more of the sort, we may afford to pass over lightly.

It is important, however, to remember in this connection, that, let these things be settled as they may, every individual, for the most part, in these times, and especially in this country, has, on one hand, the free opportunity of access to the elements of a literary education, (so far as that goes, and it ought to go a good way;) while, on the other, no necessity is imposed on him of injuring himself by either an excess or an abuse of the same. Through all this range of resources,—from what is enough to what is better or worse than enough, in most of the degrees,—he must, however, after all,—(and this is of still more importance,)—depend still, primarily and chiefly, on the guidance of the principle in himself. As we have intimated already, he must in his literature, as in his life at large, educate himself. He must, in other words, exercise for himself the appreciating and the appropriating power. He must make the most and the best of himself here again,—to recur to our definition,—by making the most and the best, among other things, of his opportunities in this department. He must use his discretion to judge, according to his circumstances first, and secondly according to what they may be, what sort of literary knowledge, or study, or discipline to be gained from it, he wants and may want, most; and how much of his time and mind can be afforded to these compared with the other matters of education, in other departments, which he wants or may want as much or more. Then he must have the industry to gather, the discrimination to select, the perseverance

to pursue, the self-denial (more than either perhaps) to forbear,—as much as possible. And to all these, and more, must be added the soul of all this process,—the principle which commands them all,—the regulator of the whole machinery,—the availing, investing, incorporating spirit of the man. It is a spirit which corresponds, pretty nearly, in the moral system, to the digestive power in the physical. It uses up all that is worth using, as it should be used, and rejects the rest. It demands, too, something to use. It will not be idle in a man. It was made to work, and will work,—upon something. If he gives it poor food, or too little, it will make the most of that, and demand more. If he omits to furnish any, it will remind him of his duty by turning in upon himself. It is the gastric juice of the mind.

This comparison affords an illustration, still farther, of the great truth that a man's education, like everything else about him, depends chiefly, not on his circumstances, but on himself; and especially so among *us*, where, as we have said, all the indispensable elements,—the alphabet of an education,—the stock to begin business with,—are placed within everybody's reach;—carried, by the vast system of moral and social machinery described before, as it were, to every man's mind, and every child's, as water in the cities is carried by conduits to every house.

The great mathematician, Edmund Stone, was a son of the gardener of the Duke of Argyle, and was seventeen years old, when his Grace, walking over his grounds one day, noticed Newton's *Principia* lying on the grass, and supposing it his own copy, directed it to be taken to its place. Stone appeared, and claimed it. "Yours!" said the Duke, "do *you* understand geometry, Latin and Newton?" "A little," answered the boy. He was far-

ther questioned, and excited the Duke's amazement still more. "And how came you with all this?" he inquired at last. "A servant," said Stone, "taught me ten years since to read.. *Does any one need to know any more than the letters, to learn everything else that he wishes?*"

There are many and obvious reasons for believing that this degree of destitution is, with many minds, at least,. and with the strongest, certainly, among the rest, not only better for them, and for their education, than the opposite state of repletion, but that it is the best position such minds, for such a purpose, can be placed in. This implies, of course, that they have a good share of the self-educating principle. In that case, their destitution operates as their most salutary discipline; and discipline, we need not attempt to show,—development of power, especially, which is the legitimate result of it, and should be the aim,—is the essence of all education. It is not what a man learns, but what he is, and what he is able to do.

If indeed abundance of means could be had in connection with this same spirit, and without injury to it, that would be well. Such is, however, but rarely the case, and can rarely be expected to happen. Abundance of means, with human nature, almost infallibly encourages negligence of appreciation, and indolence of effort.

At least, if there be not neglect, there is danger of excess. The eager mind will be tempted to surfeit on the feast spread ever before it. It will fail to discriminate, or to restrain. It will take enjoyment in the place of exertion, or out of proportion with it. It will learn to enjoy more than to endure, or to do. It will be more learned, and more contented, than it will be able or wise.

Perhaps it can hardly be called a question, on the whole, whether too much, or too little, (if too little, among us, can be conceived of,) of the mere means of education,

be better for the mind. Too much, beyond a question,—too much in this department, as in some others,—is the rock upon which most men split. It is as true that a certain sort of education in this country is too easy, and that people are therefore the less educated, and especially that they educate themselves less, as it is that the Americans (as Dr. Channing says) generally suffer more from eating and drinking, too much, than from eating and drinking too little. The poor man has the great advantage, at least, of a good appetite and a sound digestion. He gets them both by exertion. He earns them. And this is as true in the mental as in the physical department. Necessity sharpens the wits that contrive, and developes the powers that accumulate, and that use up. The poor man's knowledge,—the knowledge or study, we mean, of any man who gets with difficulty what opportunities he has,—is likely also to be of the really substantial sort. He can afford to take no trash. He wants his money's worth. He makes the most and the best, again, of his time and his place and his mind. He makes the most and the best of himself.

Still the conclusion is the same as before. It is not the means but the man that educates. It is the man that determines whether any use, and what use, shall be made of the means. If they are few or poor, he must make them go the farther, and learn the more to do without them, and to depend upon himself. He must, to borrow one of John Foster's figures, go through the world as the Indian, with his bow and arrows, goes through the woods. His facilities may be but as a pouch of parched corn in his girdle. His faculties must work the better. These are his bow and arrows, and his game must be killed as he goes. "*Does any one need to know any more than the letters?*"

And so in the other case. If our traveller starts with too much luggage, he must exercise as much discretion to be rid of the surplus, and to retain what he wants most, and to use that residue as he should. He needs the philosophy of self-education as much in the one case as in the other.

And so he needs it in all cases. He needs it, as his true nature is, not to live merely, as an animal, or to learn merely, as a man. It is, not to live to learn, but to learn to live. It is, for this end, to mature, in their due proportion, all the capacities of his constitution. It is to avail himself of *all* the means which his Maker has given him. It is, in a word, to act, and to become, as that Being designed, and as he requires him;—as he requires him, when, in his Revelation, he bids him to be also perfect as He is perfect;—as he designed him, when, at the dewy dawn of this beautiful creation around us, breathing into him the breath of his mortal life, he breathed into him a living and a deathless soul,—a spark from the flame of his own spirit,—instinct with powers as illimitable in their advancement as the flight of the far ages of the future, and destined to be but in the beginning of their career, when the stars, that sang together at their birth, shall roll no more. This will be working out God's will, and his own salvation, by working out himself. It will be working out himself, with *His* blessing, physically, intellectually, socially, spiritually,—in all things,—for time and for eternity,—the model of a Man.—And that will be the end of his Self-Education.

SEMI-MONTHLY RECORD.

THE WINTER LYCEUMS.

The operations of the Lyceums, throughout New England, so far as our information extends,—and we have happened to have, in various ways, considerable means of keeping them pretty constantly in view,—have been generally carried on, during the season which may now be said to be closed—the Lyceum Season—with a good deal of energy and intelligent spirit; we are inclined, on the whole, to believe, with more than during any preceding campaign. This was, in some respects, hardly to be expected, though in others it was to be. Those who calculated very much on the attractions of curiosity, and the love of anything *new*, and very little on the attractions of knowledge, and improvement, and emulation, and the love of anything really good, and which wears well, must now be agreeably disappointed. The Lyceum System is not yet perfect, to be sure. It is not time that it should be. It is in its infancy still; the oldest in the United States,—and that means, we take it, in the civilized world,—are not much, if any, over ten years old. Of course, it is not yet either matured in theory or established in fact. Just enough has been done in both departments,—in the theorization of the truth and in the realization of the application of it in practice,—to justify all the rational expectations of those enlightened and excellent men, (Mr. Holbrook not among the least,) who so strenuously, in the days of small things and of great doubt and coldness, exerted themselves, and even exposed their reputation to some risk, in the anxious advocacy and the laborious establishment of the scheme. The state of the case, we say, justifies such rational expectations. Though faults appear perhaps everywhere in the system, or in the circumstances of its application, or its effect, they are also diminishing. The fact that they *appear*, ought to be an encouragement. They must ap-

pear, in order to be remedied or removed. Such is actual experience, or such it ought to be, always. It has been so in this case, eminently. New improvements have been constantly making. Fresh interest has been excited in proportion. A few institutions, indeed, for special reasons,—prematurity or irregularity of formation, or some other accidental cause,—have gone into "declines," and breathed (we hope) their last—or the sooner they do the better; but others, and far more, have arisen, under better auspices—the result of reflection added to experience—and multiplied, and flourished, in every direction around us, from the St. Croix to the banks of the Hudson. The Lyceum Science was never so well understood as it is now. The Lyceum System was never in so vigorous operation. The friends of the education of the people have occasion to rejoice that it is so; and so of course have the People themselves.

The BOSTON LYCEUM we suppose to be one of the comparative veterans in this field. This institution has never been in so prosperous a condition as during the past winter. Its course of exercises has surpassed all preceding courses, in worth and interest; and their popularity has been proportional. *Patronage* we do not call it. Nobody is said to patronize himself; and this Lyceum System, well followed up, is simply the people, in their education and best improvement, taking their own business into their own hands. This they have done in Boston, so far as the work of the winter goes, beyond all example. The Lyceum has had an audience perhaps double, on an average, that of even the most active season preceding the last; say from twelve hundred to twice that number, according to circumstances; very generally a punctual, and even crowded attendance. The MECHANICS' LYCEUM has also been carried on with great interest and benefit.

The SALEM LYCEUM, though it now owns a large, ample and convenient hall for its meetings, intended to accommodate at least five hundred, has sold tickets enough to fill that room twice; and its lectures have therefore been regularly repeated on successive evenings, for the accommodation of all. The SPRINGFIELD LYCEUM has found itself none too amply provided for in the spacious town hall of that place. The same

is true at Charlestown, where the room will seat perhaps from seven hundred to one thousand. At Portsmouth, as in Boston, an old theatre has been converted into a lyceum hall. Pit, boxes, galleries, stage and all, we have seen covered with the audience; and to carry out the transformation, at Portsmouth, a small but excellent band of musicians, playing half an hour before the exercises commenced, occupied the place of the orchestra of the days gone by. This is a transformation to some purpose. The building referred to in Boston was formerly occupied by the followers of Abner Kneeland. At Newton Falls, and other places, they use a church; and this and other institutions have been in the habit of adapting their exercises, in some degree, very properly, to the sacred character of the place. The NEWTON LYCEUM has grown out of an old temperance society, the soul of which still lives, and thrives, more or less, in the body of its successor. The RUMFORD INSTITUTE, at Waltham, is another of our best lyceums, adapted specially to the factory girls and women in the place. It is also among the very oldest; we believe, ten years. At Brookline, they have gone on prosperously under the form of a debating society, with lectures by turns. In Boston, and other towns, many courses have been got up without so much of an ostensible organization, which have been attended by crowds. In the city, there have been six or eight very considerable simultaneous operations of this sort—historical, literary, scientific, miscellaneous, and otherwise.

These are signs of the times, and very encouraging ones. It is pleasant also to see the disposition manifested, not only by the mass of the community, but by those individuals among them whose example and aid are of especial importance. Our first men are taking hold of this matter;—the first in all their several departments. We have noticed with pleasure the appearance of such men as the Everetts, Sparks, Bancroft, Barber, Cushing, Farrar, Palfrey, Choate, Silliman, and other veterans in their several departments, in company and close competition with their younger associates. The introductory lecture before the WORCESTER LYCEUM, we notice, was given by one of our distinguished senators in Congress, the other of whom is the President of the Boston

Society for the Diffusion of Useful Knowledge. Our present governor has not thought it unworthy of his station, to fill the humble but useful place of presiding officer of the Lyceum in his own town, and to appear as a lecturer, in the midst of all his other duties, before that and others. This, we say, is encouraging. We want our first men to take hold with us. We want every man to contribute his share; and theirs is a large one. The People themselves must see to that. If they respect and help themselves, they will be respected and helped accordingly.

Temple of Education.—We trust that the project of erecting a building on a magnificent scale, in some central part of the city, for the use of our popular associations, will not be abandoned. It was not for want of encouragement, but in consequence of the public mind being almost entirely engrossed by the Bank question, and the pressure in the money market, that the movement made some time ago to this purpose was suspended. It was the unanimous opinion of the joint committee of the various associations, that such a building was needed in the city. The Odeon has since been made to supply the deficiency to some extent, but we believe that such an edifice is yet needed, to supply the increasing demand of the growing population of the city, for more and more of the means of improvement, of all sorts, and that it would not render any other less profitable. It would be at once an exemplary proof, and a noble monument, of the devotedness of Boston to the cause of popular education and improvement.

Hanover Lyceum.—This Lyceum was established only a few weeks since, through the enterprise of a few individuals, who were of the opinion that such a society was needed to accommodate the north and west portions of the city. Several interesting lectures have been given, and the Lyceum is now in a flourishing condition. It promises to be of considerable benefit to those for whom it is specially designed.

Mercantile Library Association.—We have by us an address delivered before this useful association of mercantile young men by Mr. Alfred Norton, one of its members. It is written in a spirit which we rejoice to discover, in productions of this kind. Though evidently prepared in haste, and without that literary finish which the author will no doubt hereafter be able to bestow upon his compositions, its generous freedom of manner, and the high aim and interesting nature of the thoughts, make it worthy the perusal of young men and of their friends.

Popular Education in Pennsylvania.—We are informed by Mr. Holbrook, who is now laboring in the cause of education in Pennsylvania, that, besides other encouraging prospects, "the Germans are coming into the Lyceum cause in a body." A capitalist offers to appropriate 5000 acres of land for a Manual Labor School, situated in Potter county.

Channing on Slavery.—We consider this treatise one of the most able and eloquent defences of that great principle of the moral rights of man—on which true liberty alone can be based—that every mind ought to be elevated and educated to the full extent of its powers, as only a free mind can be. We think the principles Dr. Channing has laid down are demonstrated by the facts collected by Prof. E. A. Andrews, while travelling in the slave-holding states, as an agent for the American Union, and which have recently been given to the public in the work entitled "Slavery and the Domestic Slave Trade in the United States."

Wonderful Results of Cultivation.—The changes which the art of the florist induces, in producing double and variegated flowers, are not to be compared with the effects of cultivation on those fruits and esculent vegetables which have been for ages under the care, and as it were the peculiar property, of man. In a wild state, indeed, they are hardly to be found at all; or *if* found, hardly recognizable. From an

insignificant and acid fruit, or rather a mere berry, (for the fruit of the wild crab is nothing more,) have been produced, it is supposed, all our large and delicious varieties of apples. The colewort, a plant whose scanty leaves weigh not more than half an ounce, is said to be the original of the cabbage. The potato was but a small bitter root, growing wild in the regions of Chili. What encouragements do not these facts afford to the cultivator who seeks to reclaim other vegetables to the use and dominion of man. And if he is, as he has been said to be, a benefactor to his race, who makes two blades of grass grow in the place of one, is not he one also who gives them a new fruit, or teaches them the use of a new plant?

A Remarkable Discovery.—A pamphlet published in Florence, last summer, contains a striking account of a discovery of a method of preserving animal bodies, far exceeding any mode of embalming ever yet known. The discoverer, an Italian, seems to have been led to the discovery by some facts which came under his observation during a journey through some of the sandy regions of Northern Africa.

The bodies, or parts of bodies, preserved by this method, retain all their characteristics of color, form and proportions, but are slightly diminished in weight, and rendered of a stony hardness, so that the sharpest file with difficulty makes an impression upon them. Even the most delicate appendages, as the plumage of birds, and the slender limbs of insects, are perfectly preserved.

American Conchology.—We observe in Silliman's Journal of Science a notice of a new and important work on this subject, by Mr. F. T. A. Conrad, who has devoted much time to the study of this subject. It is published at Philadelphia, in numbers, the first of which has appeared.

OUTLINE OF PHILOSOPHY.

BY LIEUT. ROSWELL PARK.

WE propose to offer a few general remarks on the origin, extent, classification and pursuit of human knowledge. It is a region of vast extent, and of various aspect, teeming with the innumerable productions of the intellect. It is a region, too, subdivided into many fields; and though the partition walls are not always visible, yet, on passing the line, we soon discover, by the different productions, that we are treading another soil. The human mind is naturally inquisitive, and loves to range unconfined over the wide fields of fancy, to the utmost limit of its power. Nor should the fields of science be less interesting, though there are some minds which rest satisfied in a favorite spot, while richer fruits and rarer plants grow unnoticed in the neighboring vales. Let us, then, for a few moments, cast our thoughts abroad, and soaring above all narrow limits, take, as it were, a bird's eye view of the vast regions of PHILOSOPHY; for by this term, signifying *the love of wisdom*, may all human knowledge be comprehended.

Mind and matter, active or passive, form the subjects of all our ideas; for spirit and substance are the only modes of existence with which we are yet acquainted. The *elements* of knowledge must be learned from the Book of Nature, from which all our simple or primitive

ideas are necessarily derived. But these ideas may be extended and multiplied, without limit, by the aid of Books of human production; as well as by conversation, writing, pictures and models—or descriptions and representations of natural objects. And since many natural objects are beyond our reach, of which we may still obtain adequate ideas by the aid of books, these have become the great treasuries of Philosophy, accumulated by the labors of the wise men of all ages and nations.

To give an idea of the multiplicity of books, we may refer to the European libraries.

The Royal Library of Munich, in Bavaria, the largest in Germany, contains 400,000 printed volumes, and 9,000 manuscripts.

The Bodleian Library in Oxford, the largest in Great Britain, so called because enlarged by Sir Thomas Bodley, about the year 1600, contains 500,000 printed volumes, and 30,000 manuscripts.

The Library of the Vatican, the Pope's palace, in Rome, contains about 500,000 printed volumes, and 40,000 manuscripts.

The Royal Library in Paris, *La Bibliothèque du Roi*, the largest in the world, contains, according to a late statement, 800,000 printed volumes, 100,000 manuscripts, and as many medals; besides one million of historical documents, and a million and a half of engravings. There are added to it about 15,000 volumes annually, besides manuscripts, pamphlets, prints and medals.

Compared with these, the largest libraries in our own country are small indeed. That of Harvard University contains upwards of 41,000 volumes; that of the Boston Athenæum more than 30,000; the City Library of Philadelphia about 27,000; and the Library of Congress about

25,000 volumes including in these respective numbers, books in all languages.

It is ascertained that in 1835, there were printed for the first time in the United States, about 500 different books, comprising upwards of 700 volumes; three fifths of which were original American productions. So that in order to keep pace with domestic publications alone, it would be necessary to read two volumes each day in the year, excepting Sabbaths.

D'Israeli, in his Curiosities of Literature, gives an estimate of the whole number of books printed prior to 1816, which is stated in round numbers at 3,640,000. From this and other data, we may estimate the total number of books printed up to this date, at not less than a million of volumes in the French language, as many in the German, and about seven hundred thousand in the English language, of which twenty-five thousand are American. And supposing one million and three hundred thousand volumes to have been printed in all other languages, it is probable that not less than FOUR MILLIONS of *different* volumes have been printed in the world, prior to the year 1836, including printed editions of the ancient authors. Supposing 1000 copies of each volume to have been printed, and their average size a duodecimo of 400 pages, allowing 40 volumes to a cubic foot, it would make a pile of books sufficient to cover the whole Boston Common, containing 47 acres, 50 feet deep, so that we might walk over the tops of the stately elm trees which adorn its margin.

Of the books in our own language, after deducting those which are obsolete, there are probably still left 50,000 different volumes, which would repay a perusal. Supposing then a person to read 100 pages a day, or 100 volumes a year, which is more than can be retained and

digested, it would require 500 years to read all the books worth reading in the English language alone! This result shows the importance of selection in our reading; or we may misdirect our powers, and misemploy our leisure on inferior works, neglecting the nobler and more useful.

We first perceive two distinct empires of Bibliography; one *imaginative*, the region of poetry and romance, or light literature—the other *logical*, the region of deep literature, of science and the arts. The empire of fiction and the empire of fact, they unite in the temperate zone, and their extremes diverge to the torrid and frigid zones of Philosophy. But they are not entirely distinct or independent of each other; for many plants natural to the one are found sparsely scattered over the other. There is science in poetry; and there is poetry in science—for who can study its mysteries, without experiencing emotions which constitute the essence of poetry?

The empire of fact, the region of science, has been often travelled over; and attempts have been made to give a general view of it in the form of Encyclopædias—so named from Greek words signifying the Circle of the Sciences. The principal works of this class in the English language are the following:

Dr. Chambers' Cyclopædia, or Universal Dictionary of the Arts and Sciences; first published in 1728, in 2 volumes folio. Being then a globemaker's apprentice, Dr. Chambers wrote some of the articles for it behind his master's counter.

The Encyclopædia Britannica, first published in 1788, in 10 volumes quarto; of which the seventh edition is now publishing, greatly enlarged and improved.

Dr. Rees' Cyclopœdia, commenced in 1802, and republished in Philadelphia, in 41 volumes quarto.

Dr. Brewster's Edinburgh Encyclopædia, commenced in 1810, and republished in New York and Philadelphia, in 20 volumes quarto.

The Encyclopædia Metropolitana, London, commenced in 1815, to consist of 25 volumes quarto, still publishing.

Nicholson's British Encyclopædia, commenced in 1809, complete in 12 volumes octavo.

The Encyclopædia Americana, edited by Dr. Lieber, commenced in 1830, complete in 13 volumes octavo.

Dr. Lardner's Cabinet Cyclopædia, commenced in 1829, still publishing.

In France, the great Dictionnaire Encyclopédique of Diderot, D'Alembert, Condillac and associates, had a strong influence, by its political effusions, in bringing about the Revolution.

And the Encyclopédie Méthodique, commenced in Paris, in 1782, is the largest work ever yet published; comprising 148 quarto volumes of text, and 52 of copper-plates, making in all 200 volumes.

But not one of all these Encyclopædias contains a classification of Philosophy, or human knowledge, in all its branches, so arranged as to show their relations, and give an adequate idea of the whole; nor are we aware that this task has ever been performed in a methodical manner. An attempt to effect this object has resulted in the Tree of Philosophy, which will form the frontispiece to the present volume of the Scientific Tracts. On this engraving are inscribed the names of more than fifty branches into which human knowledge is already divided. A part of these were already formed in groups, those of each group having a more intimate connection among themselves; and one of these groups had received, from time immemorial, a general distinctive name; viz., the department of Mathematics. Taking this for a model,

we have found that all the branches may be arranged in twelve departments, four of which belong to Literature, four to Science, and four to the Arts. For these departments, we have taken the liberty to borrow, from the Greek language, names which will be at once understood by all classic scholars, and which will themselves define the departments of Philosophy. These we shall now attempt to define, though most of them are doubtless already familiar to the reader. Our apology must be that the order of the subject requires it.

1. The department of BIBLIOTICS, (from *βιβλιον, a book*,) comprises those branches which are accessory or preparatory to the study of books in general, including Psychology, Grammar, Rhetoric, Logic, Criticism and Bibliography.

Psychology, or Mental Philosophy, (from *ψυχη, the soul*, and *λογος, a discourse*,) treats of the human mind, its faculties and cultivation. It also includes the subject of Phrenology, and for this has a deserved claim to attention.

Grammar, (from *γραμμα, a letter or epistle*,) treats of the structure and right use of language; or in a more extended sense, it comprehends the study of all languages, as the medium through which knowledge is communicated.

Rhetoric, or Oratory, (from *ρητωρ, an orator*,) treats of literary composition, particularly with regard to style and figures of speech; together with the rules for public speaking, or Elocution.

Logic, (from *λογικη*, its Greek name,) teaches us to reason justly, and serves to direct us aright in the investigation of truth. Its study enables us to detect sophistry, or false reasoning; and thus teaches us to correct our own errors, as well as those of others.

Criticism, (from κριτικος, *a judge*,) takes a wider range; and, investigating the principles of taste and propriety, prepares us to appreciate all productions, particularly in literature and the fine arts, at their true value.

Bibliography, (from βιβλιον, *a book*, and γραφη, *a description*,) describes all the important works which have been published, their dates, authors and subjects; thus assisting us to select our reading or study. It comprehends, therefore, a general course of Literature; and particularly Light Literature, or Poetry and Romance.

2. The department of PERICHRONICS, (from περι, *concerning*, and χρονος, *time*,) treats of the past, and includes History, Antiquities, Chronology and Biography.

History, (from ιστορια, its Greek name,) in its most general sense, is a narration of all past events whatever, with their causes and consequences; but it is here restricted to Civil History, relating to states, empires, and nations.

Antiquities, (from the Latin *antiquus*, *ancient*,) describe the manners, customs and relics of ancient nations; and thereby assist the understanding of History.

Chronology, (from χρονος, *time*,) relates particularly to the dates of events, and the manner of ascertaining them. It is therefore likewise subordinate to History.

Biography, (from βιος, *life*,) narrates the lives of eminent men, of all ages and nations; and exhibits their faults as a warning, and their excellences as an example, to all future generations. It is History restricted to individuals, and the sphere in which they were placed.

3. The Department of EPISTATICS, (from επιστατεω, *I govern*,) comprehends the subjects of Law and Government, including Legislation, and its auxiliary, Political Economy.

The term *Law*, (from the Saxon *lage*,) comprehends all those regulations established by societies of men, to govern their intercourse with each other.

Civil Law, in its more general sense, includes all the regulations which appertain to private citizens, concerning the safety of both persons and property. In a more limited sense, it is opposed to *criminal law;* the latter referring principally to persons, while civil law relates to property.

Constitutional Law, regulates the duties of public officers, and the administration of governments.

International Law, or the Laws of Nations, relates to the intercourse of nations with each other, and can only be established by their common consent.

Political Economy, (from πωλις, a *state*, and οικονομια, *housekeeping*,) treats of the means of increasing and preserving the wealth of nations; which, however, excepting the property owned by the state, consists in the wealth of individuals.

4. The Department of PROSTHEOTICS, from προς, *from*, and θεος, *God*,) comprises all religious subjects, including Ethics, Christianity, Judaism, Mohammedanism, Paganism, and Mythology.

Ethics, (from εθος, *morals*,) called also Morality, and Moral Philosophy, treats of the duties of mankind toward themselves, their fellow men and their Maker. Although founded on the constitution of our nature, its structure was incomplete, without the aid of the gospel.

Christianity investigates the evidences on which the gospel rests, describes its doctrines as understood by all the various sects, and enforces its divine precepts by the sanction of revelation. It comprehends, therefore, the subjects of Christian Divinity and Theology.

Judaism describes the tenets and ceremonies of the Mosaic Law, as still retained by the dispersed and wandering Children of Israel.

Mohammedanism, Moslemism or Islamism, treats of the doctrines and writings of the self-styled prophet of the Arabians.

Paganism, (from the Latin *paganus, a peasant* or *a pagan*,) describes the various idol worship and superstitions of the heathen nations.

Mythology, (from μυθος, *a fable*,) treats of the heterogeneous, alternately beautiful, sublime and profligate fabulous deities of the classic ages of Greece and Rome.

5. We come now to the Sciences. The Department of Geotics, (from γη, the earth,) treats of the globe which we inhabit, its composition and productions; including Geography, Chemistry, Mineralogy, Geology, Botany and Zoology; or all the branches of Natural History.

Geography, (from γη, *the earth*, and γραφη, *a description*,) comprehends a general view of Geotics, particularly with regard to Topography, or the location of animals, plants, and all natural objects; including also the statistics of the different nations.

Chemistry, (from the Arabic *kimia*, the *occult science*,) investigates the properties of all material substances, resolves them into their simple elements, and re-combines them in innumerable forms, by the aid of those mighty physical powers, attraction, affinity, light, heat, and electricity; thus subserving important purposes in all the practical pursuits of life.

Mineralogy, (from the French *mine, a mine*,) describes earthy and mineral substances in detail; and by the aid of Chemistry, investigates their composition and uses.

Geology, (from γη and λογος,) examines the earths and minerals on a large scale, as forming the earthy and rocky strata which constitute the crust of our globe. By the fossil and organic remains which these contain, it discovers the early races of animals which inhabited the earth, and the changes which it has undergone; thus tracing, as it were, the history of the creation.

Botany, (from βοτανη, its Greek name,) treats of the trees, plants, and other vegetable productions of the earth, the physiology of their growth, and their localities and uses.

Zoology, (from ζωος, *living*, and λογος,) describes all animals which are known to the naturalist,

"Beast, bird, fish, insect, what no eye can see,"

from the senseless polypus, and crawling worm, to the "half reasoning elephant," and man, the lord and master of them all.

The Department of THERAPEUTICS, (from θεραπευω, *I heal*,) relates to the physical constitution of man, and the means of restoring and preserving health. It comprises Anatomy, Physiology, Medicine, Surgery, &c.

Anatomy, (from ανατεμνω, *I dissect*,) describes the parts of the human body, and its wonderful organization, that "harp of thousand strings," as Dr. Watts so beautifully terms it, so easily disordered by accident, imprudence or excess, that it is indeed strange that it "should keep in tune so long."

Physiology, (from φυσις, *nature*,) investigates the uses or functions of those organs which Anatomy describes; and has been greatly aided by experiments on various animals, which are thus made beneficial to man.

Medicine, (from the Latin *medico*, *I cure*,) in its most general sense, treats of Hygiene, or rules for the preser-

vation of health; of the Materia Medica, or substances used in medicine, and of the classification, symptoms, and cure of diseases.

Surgery, (from *χειρουργια, the work of the hands,*) relates to the treatment and cure of wounds, fractures, &c. often requiring painful *manual* operations.

7. The Department of MATHEMATICS, from *μανθανω, I learn,*) so called by way of eminence, treats of all quantity which can be measured by a standard unit, and thus expressed by numbers. It comprehends Arithmetic, Algebra, Geometry, Fluxions and Variations.

Arithmetic, (from *αριθμος, a number,*) treats of calculations by means of the Arabic numerals—the nine digits and the cipher—used in the decimal notation.

Algebra, (an Arabic term,) represents numbers by means of letters, and their relations by other symbols; enabling us to use unknown quantities as if they were known, and thus by their relations to ascertain their value. It is a more general kind of Arithmetic.

Geometry, (from *γη, the earth,* and *μετρον, a measure,*) treats of the measure of space, by lines, surfaces and solids. Analytic Geometry depends on Algebra, and includes Trigonometry, or the properties of Triangles, and Conic Sections, or the curves obtained by a plane intersecting a Cone. Descriptive Geometry includes all the principles of Projection and Perspective, the foundation of the art of Drawing.

Fluxions, (so named by Newton,) or the *Differential and Integral Calculus,* (as it is termed by the French,) investigates quantities supposed to be produced by the continual addition of small increments; as the flowing or motion of a point produces a line; the motion of a line gives a surface; and the motion of a surface generates a solid.

Variations are a refinement of Fluxions, by the use of which Laplace, in his "Méchanique Celeste," or Mechanism of the Heavens, has unfolded the laws of planetary motion, to an extent which leaves comparatively little to be desired in this sublime branch of science.

8. The Department of PERIPHYSICS, or Natural Philosophy, (from περι, *concerning*, and φυσις, *nature*,) treats of those phenomena of nature which are connected with the motion of solids and fluids, air, light, electricity, &c., under the names of Mechanics, Optics, Electricity, Magnetism, and Astronomy.

Mechanics, (from μηχανη, *a machine*, treats of the laws of forces, the mechanical powers, the theory of gravitation, and the motion and pressure of fluids. *Acoustics*, (from ακουω, *I hear*,) investigating the theory of sounds, may also be included in this science.

Optics, (from οπτομαι, *I see*,) treats of the phenomena of *light*; whether it consist in the vibration of particles of matter, or whether, as is more probable, it be an imponderable substance, moving with immense velocity.

Electricity, (from ηλεκτρον, *amber*,) treats of the wonderful effects of the electric fluid, from the electrifying power of amber, in which it was first discovered, to the bolted lightning, which shakes the heavens, and makes the earth tremble. When developed by the galvanic battery, it is the most powerful chemical agent with which we are yet acquainted.

Magnetism, (from μαγνης, *the loadstone*,) investigates the attraction first observed in a native oxyde of iron, which pointing in a known direction, though not always to the north, serves to guide the wandering mariner. It has probably a more intimate connection with Electricity than has yet been ascertained.

Diagraphics, or Scientific Arts.

Astronomy, (from *αστηρ*, *a star* and *νομος*, *a law*,) examines the orbs of heaven on their trackless way, which they have pursued, for ages, with such precision, that their exact places may be calculated for any epoch, past or future, from the beginning of time till time shall be no longer.

9. We are now come to the division of the Arts. The Department of DIAGRAPHICS, or the Scientific Arts, (from *διαγραφω*, *I delineate*,) comprehends Surveying, Architecture, Navitecture, Navigation, and Civil Engineering; all of which depend much on drawing, or delineation, in their practice.

Surveying treats of measuring, laying out and dividing land.

Architecture, (from *αρχος*, *chief*, and *τεκτων*, *a builder*,) embraces the principles and practice of building, as regards both beauty and usefulness. It depends on rules of taste and fitness, which have been sanctioned by the test of ages.

Navitecture, (from *ναυς*, *a ship*, and *τεκτων*, *a builder*,) called also Naval Architecture, treats of the construction of vessels—one of the most difficult branches of the arts, as it is one of the most useful.

Navigation, (from *navigatio*, its Latin name,) by the aid of astronomy, enables the ponderous ship, with her pigmy crew, to traverse the ocean, and circumnavigate the globe; the mighty agent of commerce and civilization.

Civil Engineering, (from the Latin *ingenium*, *skill*,) comprehends the construction of common roads, railroads and canals; with the improvement of rivers and harbors. Its applications of the mighty power of steam are perhaps the grandest triumph of art over the latent energies of nature.

10. The Department of TECHNICS, or the Mechanic Arts, (from τεχνη, *an art*,) comprehends Agriculture and Manufactures—the arts most necessary to the maintenance of human life.

Agriculture, (from *ager*, *a field*, and *cultus*, *culture*,) treats of the tilling of the ground, and the raising of domestic animals. *Horticulture*, (from *hortus*, *a garden*,) relates to the cultivation of culinary and ornamental plants, fruit and flowers.

Manufactures, (from *manus*, *the hand*, and *facio*, *I make*,) include all those pursuits which are termed trades, and those which are carried on by machinery in shops. They may be classed into those of food, clothing, furniture, carriages, and ornaments; including workmanship in the metals, stones, glass, horn, shells, wood and other substances, earthy, animal and vegetable.

11. The Department of POLEMICS, (from πολεμος, *war*,) treats of belligerent operations, and includes Tactics, Fortification and Strategy.

Tactics, (from τασσω, *I arrange*,) relate to the exercise of troops in marching and fighting, and is subdivided into three principal branches. *Infantry Tactics* relate to troops which use the musket or rifle; *Artillery Tactics* to those whose weapon is the cannon, and *Cavalry Tactics*, to those who fight on horseback, with the pistol or carbine, and the sword.

Fortification, (from the Latin *facio*, *I make*, and *fortis*, *strong*,) termed also Military Engineering, comprehends the construction, attack and defence of Forts, Redoubts, Breastworks, &c., to aid in resisting or conquering an enemy.

Strategy, (from στρατηγος, *a leader of an army*,) treats of all the measures by which a general conducts a

campaign; the supplies, discipline and manœuvres of an army in the field.

12. The Department of Cosmics, or the Fine Arts, (from κοσμεω, *I ornament*,) includes Music, Painting, Sculpture, Heraldry and Gymnastics.

Music, (from μουσικη, its Greek name,) treats of melody and harmony; the former being a succession, and the latter a consonance, of agreeable sounds. The musical scale is as accurately fixed by the laws of acoustics, as the orbits of the planets by the laws of gravitation.

Painting, (from the French *peindre, to paint*,) represents objects on surfaces, according to the principles of perspective, including the various modes of Drawing and Engraving.

Sculpture, (from the Latin *sculpo, I carve*,) embodies in brass, marble, &c. the ideal forms of the poet, novelist or historian; and preserves for future ages the likenesses of those great men who "darkened nations when they died." The sculptor and the painter differ only in working with different tools, their object being the same.

Heraldry, (from the French *hèraut, a herald*,) regulates the formation and transmission of coats of arms; derived from those insignia which the closed visor of the knight errant rendered necessary to distinguish him in battle.

And *Gymnastics*, (from γυμναζω, *I exercise*,) includes those active pursuits which are followed principally for amusement, as archery, fencing, hunting, fishing, sailing, riding, driving, running, wrestling, dancing, &c.

We have thus endeavored to enumerate all the branches of Philosophy, to define their objects, and to arrange them according to their most intimate relations; trusting that the reasons for this arrangement will present them-

selves to the intelligent reader, on inspecting the accompanying diagram—the Tree of Philosophy. We cannot flatter ourselves that this classification is perfect, or that it will please all who examine it; but we offer it as the result of much study and reflection. Some branches are so related to many of the others, that it is difficult to say with which they are most intimately connected; and there is such a concatenation of them all, that on any one of them, as the basis, we might write an Encyclopædia.

All these branches of knowledge originated in the necessities, the ambition or the luxury of mankind. To *necessity* we owe the arts of preserving life: to *ambition*, the arts of aggrandizing and the arts of destroying life; and to *luxury*, or the love of pleasure and the love of learning, we are indebted for all the rest, save the most precious of all, the knowledge which was given us directly by divine inspiration. The arts gave birth to the sciences, and these grew upon each other, in their turn assisting the arts. As wealth increased, bringing with it refinement and leisure, new subjects engaged attention, and thence originated new studies, some of which have stood the test of time, while others have sunk to oblivion. Bacon's Novum Organon dissipated the ancient Logic; Alchemy vanished as Chemistry rose from its ashes; Astrology expired with the birth of Astronomy; and Heraldry, in this republican country, serves merely to preserve in wax the once precious seals of our ancestors. An improvement in one art or science frequently gave rise to improvements in many others. The discovery of the magnet aided Navigation; the extension of Navigation enlarged Geography; and Geography assisted Natural History. All the inventions and improvements

which increase wealth, and thereby the leisure of mankind, tend indirectly to the increase of knowledge.

In Architecture and Sculpture, the Grecian models remain unrivalled; but all the other branches of knowledge known to the ancients have been greatly improved by the moderns; and many branches have been added which were formerly unknown. Chemistry and Geology, Fluxions and Variations, Electricity and Magnetism, have sprung to light since the dark ages. History, Biography, &c. have been regularly accumulating since the origin of writing. The art of printing, and the applications of steam, have brought the learned men of all nations, as it were, into *immediate contact;* and the discoveries of an individual are soon known to the whole civilized world. The arts of man, which make "fire, flood and earth subservient to his will," seem gradually to be overcoming the perversities of nature; and in this probationary state of being, their exercise is doubtless a moral good, tending to preserve us from idleness and its attendant vices.

But vast as this amount of knowledge is, it has its limits, depending on the constitution of our nature. All our knowledge is derived by the aid of our senses; and where these fail, we can go no further, till Heaven shall grant us new faculties. Without the sense of *seeing*, we should be ignorant of the existence of light; it would still exist, but we should be none the wiser thereby, and should know nothing more of colors than the blind man, who thought that *red* was like the sound of a trumpet. Our knowledge of Astronomy is limited by the imperfection of vision. Could our sight become more acute, or more powerful glasses be constructed, we might still discover more new planets, and stars which have not yet been distinguished. We know many properties of matter,

such as shape, size, color, weight, cohesion, gravitation, &c., but of its ultimate constitution we know nothing. By what organization of particles snow is white and coal is black, no philosopher has yet been able to explain. The fluid of electricity pervades all space, as much as the air we breathe, yet this fact was not discovered till a recent period. What other unknown fluids exist, and exert their agencies on matter, is more than we can say. Were we endowed with new senses, we might make discoveries as wonderful to us, as sight to the blind man. Of spiritual existences, beyond our own minds, we know nothing, except by revelation, because we have no sense adapted to perceive spiritual beings. What changes the death of the body and releasement of the soul may produce, we cannot tell; but can conjecture, when we see the bright butterfly emerge from the dusty chrysalis, and soar aloft in the air.

We come now to the last topic proposed, the pursuit of knowledge, as adapted to the various stations of life. Though some stations are more favorable than others for this pursuit, yet the field is open to all, and even the humblest may glean a competence from the rich harvest before him. Our schools are open alike to the rich and the poor, to acquire the arts of reading and writing, grammar, and the elements of arithmetic and geography;—and were our legislators to provide the means, and compel all youth to acquire these branches, they would prepare them for greater usefulness, prevent much crime and misery, and greatly benefit our country. The humblest laborer or mechanic has leisure to read his Bible on the Sabbath, his newspaper in the evening, and occasionally a volume of natural science, history, biography, poetry, or romance, calculated to make him both wiser and better. But the professional gentleman has no excuse if he neglect the

cultivation of his mind both in science and literature; for any acquisitions of knowledge cannot fail to be useful to him, directly or indirectly, sooner or later. And the chief advantage which the gentleman of wealth and leisure enjoys over his fellow men, is in the greater means of improvement as the means of greater usefulness—neglecting which, he abuses the gifts of Heaven, and incurs the censure of the unprofitable servant who hid his lord's money.

A *liberal education* properly includes some general knowledge of every branch of philosophy—of its objects, its uses, and the mode of its pursuit. After acquiring this, the aspiring student is at liberty to devote himself to his favorite branches; and will be the better prepared for them by these preliminary studies, from which he may derive extraneous aid when his favorite resources are exhausted. A well selected private library, therefore, should contain at least one good book on every branch of knowledge. Beyond this, professional works, or works of literature may predominate, according to the proprietor's peculiar taste and pursuits.

Perhaps at the present day there is danger of dissipating our faculties, and after acquiring general ideas of all the sciences, attempting to master them all—which is impossible. He that would excel, must devote himself to one pursuit. Let him examine all before making his choice; but having once chosen, he should be as constant to his favorite study, as the lover to his heart's idol, if he would win distinction.

Another prevailing error of the present age, perhaps, is promiscuous and excessive novel reading. We are advocates of novels, *of a certain class;* not such as paint unnatural scenes of mystery, magic, or erratic passion—but such as describe real life, and thus convey to us a

knowledge of men and manners derived from the experience of their authors. The works of Scott, Bulwer, Cooper, and some others, we regard as a part of our classic and standard literature. Of Miss Sedgwick's and Miss Edgeworth's novels we would record our unqualified approbation. But though many other novels are worth reading, we would suggest that there are many other books much more so; and we cannot approve the taste which runs after every new novel, while such works as the Idler, the Rambler, the Spectator, and our classic poets and historians, are neglected. To a mind not vitiated by habit or false taste, the writings of Herodotus, Thucydides and Xenophon—of Livy, Tacitus and Sallust—of Gibbon, Hallam and Russell—of Homer and Virgil—of Milton, Shakspeare and Byron—of Cowper and Thompson—of Addison, Johnson and Goldsmith—of Marshall, Ramsey and Irving—of Miss Hannah More, Mrs. Hemans, and Mrs. Sigourney,—would be at least as entertaining as a majority of the novels, and far more instructive.

In conclusion, we would suggest, that short as life is, and precious as time ought to be, we should read only the best authors, and read them carefully; select the best of their ideas, and make them our own; remembering that we are thereby forming our minds for usefulness here, and happiness hereafter.

SEMI-MONTHLY RECORD.

PROF. SILLIMAN'S LECTURES.—This valuable course of lectures is just closed. Mr. Silliman's interesting manner, his perfect familiarity with the subject, and his superior experimental illustrations, have attracted very numerous audiences. Of course he was able to compress but a small portion of chemistry into twelve lectures, but he has done enough to place our citizens under great obligations for his labors. They cannot but serve to increase the interest of the community in this important branch of study.

THE LYCEUMS, AGAIN.—In addition to the list of flourishing Lyceums, described in our last number, the Dedham Patriot mentions those at Dedham, Walpole, Taunton, &c., and remarks that some of these societies have employed lecturers for the season, and that with others, debates upon the popular questions of the day, and lectures by the members themselves, have been the plan of operation. The members of the Young Men's Lyceum, in the south part of Dedham, have been quite active, and we doubt not have derived much benefit from the association.

MECHANIC APPRENTICES' LIBRARY ASSOCIATION.—The mechanic apprentices deserve much credit, for keeping this establishment in such good order and in so flourishing a condition. An address delivered by one of their number, Mr. Seaver, last summer, is a favorable specimen of what a young mechanic may do, in the way of intellectual improvement, and shows that the author may hereafter be capable of much better things.

Water.—An interesting Lecture on this subject was recently given by Dr. C. T. Jackson, before the Hanover Lyceum. The substance of it, with the result of some further investigation relative to the water of Boston, will doubtless constitute the fourth number of this series of the Tracts, which will appear the 15th of next month.

Leafless Plants.—It is a remarkable fact that plants which are without leaves are also invariably destitute of the green color which marks the greater portion of the vegetable creation. It is interesting to observe in this connection the general principle stated by Prof. Silliman in the course of his lectures, that only the green plants exhale oxygen at any time. The connection of these facts gives us a hint (though nothing more, it must be confessed) at the reason of the almost universal prevalence, as well as the mediate causes of the existence of this delightful hue in the leaves of plants. We must undoubtedly ascribe it to the oxygen in them, by whose vitalizing operations the vegetable life is sustained.

Effects of Knowledge.—It is not more evident that the body was made to be improved and strengthened, than that the mind was also made to be improved by knowledge. And he who learns, if he learns well, not only finds learning easier the farther he advances, but understands better what he learns. For science is not arbitrary, or composed of detached and isolated parts; but it is all one connected series of truths, centering in Deity, and embracing the largest and smallest, the nearest and the most remote portions of his universe. So he who learns not, or ceases to learn, does not fulfil his destiny—which is, to become acquainted, as far as in his power, with all truth. He can know neither his Creator nor himself; although his greatest happiness depends upon this knowledge.

Scientific Exploration.—Attempts are making in London to fit out a new expedition of discovery to Africa. The project is to begin at the south, and proceed northward, by *caravan.*

A Simile.—Associated effort, though much greater than that of individuals, is not powerful in proportion to the amount, so to speak, of the power of its individual elements. We may compare it to the motion of an extensive combination of pulleys—strong enough, indeed, to raise vast blocks and pillars of granite, but operating slowly, and losing an enormous amount of force in the overcoming of friction among its parts. And there is yet this farther disadvantage in these engines of moral power—as the associations of these days may be considered to be—that every member of them cannot work with its due force, many of them being comparatively powerless, while a few have almost entirely to themselves the management of the ropes. Still these associations are vastly useful. They are indispensable. Without them, the mountains which lie in the way of our intellectual and moral improvement could not be removed—the pillars of the temples of science and of truth which we erect, could not be elevated.

Manufacture of Soda.—In France, the demand for soda in the arts is so great, that it cannot be supplied by the ashes of marine plants, from which it is usually obtained. Manufactories have therefore been established for obtaining it by decomposing common salt, which is a compound of muriatic acid and soda.

Submarine Register Barometer.—This is the title of an instrument constructed by Mr. Paine, of the Adelaide Street Gallery of Practical Science, in London, to ascertain the depth of water by its pressure on a column of fluid, the graduation of which is into degrees, each equivalent to the pressure of an atmosphere, and subdivided into tenths.

Experiments on Steam-Boilers.—The Franklin Institute of the state of Pennsylvania are publishing in their Journal the results of experiments made by them on this subject, at the request of the Treasury Department of the United States. It is probably one of the most able and satisfactory scientific reports which have been made in our country.

SCIENCE, the partizan of no country, but the beneficent patroness of all, has liberally opened a temple where all may meet. Her influence on the mind, like that of the sun on the chilled earth, has long been preparing it for higher cultivation and farther improvement. The philosopher of one country sees not an enemy in the philosopher of another: he takes his seat in the temple of science, and asks not who sits beside him.

MR. GRAHAM has met with considerable favor from a large portion of those who have heard his lectures in this city on the Science of Human Life. He is a much more thorough student in the department in which he is engaged than is generally supposed, though doubtless a sinner in some respects, like all other men.

An address was delivered before the Boston Young Men's Institute, at its last annual meeting, by Mr. D. B. Harris, a mason by trade, and president of the society. Both its matter and execution are creditable to him and the institute, as a literary effort of a practical man.

THE TRACTS.—We intend to observe as much system in arranging the subjects of the Tracts, as the nature of our plan will permit. The first of this series was designed as a sort of introduction—it being the main object of the work to aid in self-education. In this number all the various branches of knowledge are defined and briefly explained—and each of them will be discussed more at large as fast as treatises can be obtained which we shall deem suitable for our pages.

ADVANTAGES OF EARLY RISING.

BY Dr. WM. A. ALCOTT.

Antiquity of Early Rising. Testimony in its favor.

A certain French author has devoted a large volume to what he calls the subject of "Gaiety"—or as we should say, Cheerfulness—in regard to its tendency on health and happiness; and we cannot doubt that the work is one of great value and interest. We might, in our turn, easily extend remarks on early rising to a considerable volume, but it would not comport with our plan. On the contrary, we must limit ourselves to a few pages.

Early rising is a practice of great antiquity, and has been followed by some of the most distinguished individuals of every age and clime. Not by the great men of *sacred* history alone—Abraham, Moses, David, Solomon and Paul—but by those also of profane history; such as Homer, Virgil, Seneca, Horace, Alfred, Sobieski, Franklin, Washington, and Napoleon.—It may not be improper to add, in this place, that the Saviour of the world, himself, was an early riser.

The testimony of distinguished writers in favor of the practice, is almost universal. Scarcely an author of any eminence can be found, who has alluded to the subject without expatiating on its importance; and not a few enjoin it with the greatest earnestness, as indispensable to sound health, and even moderate happiness.

And yet, notwithstanding the universal practice or testimony of poets and philosophers—of sacred and profane

history—of antiquity and modern times—and of medical and other authors, the custom of sleeping late, in almost all countries, is still followed by the vast majority of mankind; and the pulpit and the press, the sermon, the essay, and the song, have been enlisted against it nearly in vain. Mankind are far more ready to concede the importance of rising early, than to regulate their practice accordingly.

It may be asked, What, then, has the writer of the following essay to hope for? Very little, it is confessed. Yet that little must not be overlooked. His very brevity—his few condensed pages, in lieu of a labored sermon or prolonged and grave essay, may have an effect. He will therefore proceed without despondency.

It is proposed to show that early rising is favorable to PLEASURE and CHEERFULNESS, to HEALTH and LONGEVITY, and to SOUND ECONOMY; and to conclude by pointing out, to those who are anxious for information on the subject, the MEANS of acquiring this most valuable habit.

PLEASURES OF EARLY RISING.

These are more easily felt than described; and were it possible to describe them, our language would to most persons be unintelligible; because they have never enjoyed them. Those who sit up late, can speak of their enjoyments, and they may perhaps insist on *their* superiority to those of the early riser; but if they never tried the latter, their whole testimony against them is merely *negative*. On the contrary, the testimony of him who *once* rose late, but now habitually rises early—and such are many of our early risers—is wholly *positive;* because he has had an opportunity of making comparisons.

But it is not the testimony of such men alone, which we can adduce in favor of early rising. Those who still

adhere to indolent habits, are often compelled by conscience to testify against themselves. Thus it was, we are told, with the poet Thomson. No man, perhaps, ever wasted more of the first hours of day than he; and yet how beautifully he describes the pleasures of early rising on a fine summer morning!

> " Falsely luxurious, will not man awake,
> And springing from the bed of sloth, enjoy
> The cool, the fragrant, and the silent hour,
> To meditation due and sacred song?
> For is there aught in sleep can charm the wise?
> To lie in dead oblivion, losing half
> The fleeting moments of too short a life,
> Wildered and tossing through distempered dreams!
> Who would, in such a gloomy state, remain
> Longer than nature craves, when every Muse
> And every blooming pleasure wait without,
> To bless the wildly devious morning walk."

No mere prose description of the pleasures of early rising is more graphic, however, than that of Macnish, in his celebrated work on the Philosophy of Sleep. We presume, by the way, that Macnish himself was an early riser.

" There is no time," says he, "equal in beauty and freshness to the morning, when nature has just parted with the gloomy mantle which night had flung over her, and stands before us like a young bride, from whose aspect the veil which covered her loveliness has been withdrawn. The whole material world has a vivifying appearance. The husbandman is up at his labor; the forest leaves sparkle with crystal dew; the flowers raise their rejoicing heads towards the sun; the birds pour forth their anthems of gladness; and the wide face of creation itself seems as if awakened and refreshed from a mighty slumber."

Solomon also says, in language of very great beauty as well as force—"Let us go, forth into the fields; let us lodge in the villages; let us *get up early* to the vineyards; let us see if the vines flourish—if the tender grape appear—if the pomegranates bud forth." Whether, after all, Solomon was not compelled by the Spirit of Truth to testify in favor of a practice which, in his late years, he neglected, may admit of some debate. *Solomon lived at court.*

But no testimony strikes us more forcibly than that which is afforded by the practice of the peasants of Switzerland and some other parts of modern Europe. See them at the very dawn of day going forth, young and old, male and female, with the most joyous looks, lively steps, and animated expressions, breaking forth sometimes into cheerful and joyous songs. Their hymns to the rippling stream, to the towering cliffs, or to the tall forests, are scarcely exceeded in beauty or melody by the rapturous notes of the feathered tribes themselves. Above all, how would it move the heart of a stranger to such customs, to observe the spirit with which they unite their voices in a hymn to the rising sun. If there are joyous, as well as FREE spirits on the face of the wide world, they are these; although under the nominal control, it may be, of despots.

Why all this? Why does the morning inspire us with cheerfulness? Refreshing slumbers have placed the nervous system, and indeed the whole physical frame, in such a quiet and happy state, that the operations of the mind, and the affections and emotions of the soul, cannot otherwise than be healthy and harmonious; and these produce, as the almost necessary result, a degree of pleasure which is far better felt than described.

If the first morning of May were not, in this respect, like all other mornings of the year, we might hesitate

about reminding our readers of the cheerfulness which in some countries is awakened by the first hours of May-day. But we believe, that those who will renounce the chains in which indolence has fast bound them, and resolve from this day forth to rise betimes, and enjoy what there is to be enjoyed at the "cool fragrant hour" of early dawn, will find a cheerfulness connected, not only with May-day morning, but with every morning in May; and not only with every morning of May, but with every morning of the year.

No laborer—be his employment mental or physical—can fail to perceive, if he will but make the experiment, that he can never perform his labor with so much ease and cheerfulness as in the morning. Though the philosophy and physiology of all this were difficult of explanation, the facts are most obvious. And we say, therefore, that he alone who has once tasted the cheerfulness which is inspired by early rising, is prepared at all to appreciate it.

No student, especially of nature, will ever find so appropriate an hour for walking abroad, as the morning. That father, or mother, or teacher, who wishes to inspire a dull child or pupil with a love for nature, should, by all means, go forth into her society at this cool, silent, and we may add, sacred hour. To those who fear the early dew, the morning is still delightful. The pleasures, even of the parlor or study, are redoubled to the habitually early riser, though he should refuse to go forth and welcome the first beams of the rising sun.

Health and Longevity.

We are not ignorant that the question has been agitated, whether the morning air, is, after all, more healthful than that of the evening. The full day of sunshine, it is said

by some, has destroyed the vapors, and the poisonous effluvia; and why should not the air of the evening, ere the long night has allowed more vapors to accumulate, be healthier than that of the morning?

But it should be remembered that every individual is somewhat weakened at evening, whether he *perceives* it or not. This is proved by the fact, that the contagion of disease more readily affects a person at this hour than at any other, since it is well known that our systems are accessible, in this respect, in proportion to our want of health or vigor. It is also farther proved by the more obvious fact, that the pulse is always more or less increased at evening; and this increase is known to be the result of weakness or debility. Now if the external causes of disease—dampness, effluvia, &c.—were even present as much in the morning as in the evening, we should be less likely to be affected by them, because sleep has restored our wonted tone and vigor; and consequently our power of resisting the surrounding evil influences.

The advantages of early rising in reference to health, are, however, so many and so obvious, that we need not dwell upon those which are doubtful. We should be willing to concede, for the moment, that the air of the evening is as salutary as that of the morning; and that we were no better able to resist the bad tendencies of the one, than those of the other. For even then, these truths would still remain, well attested by abundant experiment, that sleep in the night is better adapted to the wants of human nature than sleep in the day time, and that the more nearly this sleep is divided between the hours before and after midnight, the more favorable it is to health and longevity.

The character of the early riser, says Macnish, is the very reverse of that of the sloven. His countenance is

ruddy, his eye joyous and serene, and his frame full of vigor and activity. His mind is also clear and unclouded, and free from that oppressive languor, which weighs like a nightmare upon the spirit of the sluggard.

The same writer in another place also observes—The most striking instances of the good effects of early rising are to be found in our peasantry and farmers, whose hale complexions, good appetites, and vigorous persons, are evidences of the benefit derived from this custom, conjoined with labor; while the wan, unhealthy countenances and enfeebled frames of those who keep late hours, lie long in bed, and pass the night in dissipation, study or pleasure, are equally conclusive proofs of the pernicious consequences resulting from an opposite practice.

Among the experiments which go to show that it is not conducive to health to convert night into day, or day into night, is the following. It is related by Valangin, and though often quoted, is never tedious.

Two colonels in the French army had a dispute whether it was most safe to march in the heat of the day, or in the evening. To ascertain this point, they got permission from the commanding officer to put their respective plans into execution. Accordingly, the one, with his division, marched during the day, although it was in the heat of summer, and rested all night. The other, with his men, slept in the day-time, and marched during the evening and part of the night. The result was, that the first performed a journey of six hundred miles, without losing a single man or horse; while the latter lost most of his horses, and several of his men.

We have said, that the circulation of the blood is quickened at evening. This is the case even with those who are healthy; but the increased action is most obvious in the feeble. This increased activity is a state of diminutive

fever; and this febrile state should be prolonged as little as possible. Every person, we would say again, should retire early enough to procure half his sleep before midnight. Stanislaus I, of Poland, always observed this rule. He retired regularly at nine, and rose at three.

One reason why sleep in the night is more salutary than that of the day, may be found, most undoubtedly, in the fact, that impressions on the external senses are more fully excluded. Light may affect us, even though we close the eyes; and hence the utility of darkness. Sounds disturb us, even though we do not wake, and hence the importance of that superior quietude which usually accompanies darkness.

Another reason is, that almost every individual either has some business assigned to each day, on which his mind, if he lies down, is apt to linger, or he has friends to whose calls or interruptions he knows he is liable. In this view alone, it were impossible for any but the merest sluggard to consign himself to the same quiet, sound sleep in the day-time as in the evening.

We are now prepared to state that one principle advantage to health resulting from early rising is, that it drives us to bed early. He who rises at four, will not long sit up till eleven, or twelve, or one. Nature may be wronged for a time, but her demands are so imperious, that few will persevere in resisting her, even when fashion is with them. So long as people are permitted—or rather permit themselves—to lie in bed till six, seven, or eight o'clock in the forenoon, so long will they be unable to resist the temptations to sit up to an hour which is unfavorable to health. But when they have once succeeded in rising at four uniformly, they will be apt soon to learn to retire at nine or ten. Hence arises the greatest share of gain which is derived from early rising.

But it may be urged that all this is mere theory, unsupported by fact. Very far from it. No truth is better sustained than that early rising is, somehow or other, connected with health; and that sitting up late is, somehow or other, less favorable to health and longevity. We have insisted that these results follow both directly and indirectly; but principally, as we have shown in the preceding paragraph, indirectly.

Among the evidences in favor of early rising are the following considerations and facts:

Few persons reach a remarkably old age, who have not been in the habit of early rising. Some writers indeed affirm that the rule is so general as to admit of no exceptions.

Nearly every man who has distinguished himself in science, literature, or the arts, has been an early riser. The industrious, the enterprising, the ambitious, the enthusiast in pursuit of knowledge—all these are up early at their respective posts; while the sluggard is wasting the most delightful portion of his existence in slumber.

We have already mentioned a number of great or good men who were early risers. We propose to add a few more of those striking cases, found everywhere on the page of history.

The story of Buffon the naturalist, is an eminent instance of attachment to early rising. He ordered his *valet de chambre* to awake him every morning before the clock struck six; and if he evinced any reluctance to get up, to compel him to do so. For this service he was rewarded a crown a day. If, however, he neglected to perform his duty to the very letter, he forfeited the crown.

Sir Thomas More rose every morning at four o'clock; and it is worthy of remark, that in his work called "Utopia," he represents the inhabitants of that highly

favored region as attending lectures before sunrise.—Nothing could better show his conviction of the beneficial effects of early rising.

Paley, indolent as he naturally was, acquired at college—uncommon as such facts are—the habit of rising early; and it is believed that the world is indebted to this circumstance for his most excellent productions.

Priestly who performed more labor, in his department, than almost any man that ever lived, was an early riser.

Bishops Jewel and Burnet, Jeremy Taylor, Baxter, Wesley and Matthew Hale, rose regularly by five o'clock, and most of them by four.

Stanislaus I. and John Sobieski, kings of Poland, Charles XII., Frederic the Great, Alfred and Napoleon, were all distinguished for the same habit. Sobieski and Stanislaus rose at three or four, and the former never slept but four hours.

Few men have accomplished more in the same period of time—and perhaps few persons of his age are more efficient and healthy—than Lord Brougham. And yet, this distinguished statesman is said to sleep but four hours; and is always up early in the morning. The Duke of Wellington is also an early riser.

Copernicus, the astronomer, who was a native of Thorn in Poland, with no less than nine of his countrymen who were distinguished for literature, and whose names are conspicuous in the Encyclopædia Americana, were all remarkable for their early rising.

Basile Lanneau, of Charleston, S. C., the descendant of a French family, who was at ten years of age a friendless destitute orphan, by his industrious and virtuous habits became wealthy and respectable; and lived to the age of eighty-eight years. For thirty years of his life, it is said that the sun never found him in his bed.

James Mason, of Scott county in Kentucky, was an early riser. A few years since, when over one hundred years of age, he could walk thirty miles a day; and his walk was erect and lively. We believe he is still living.

We will mention two or three more examples of early rising, and those shall be national.

The Polish peasants—and the same is true generally of the peasants of Switzerland and Austria—rise every morning, during spring, summer and autumn, at three o'clock or earlier; and in winter, they are never in bed after four. They perform at least half an ordinary day's work for themselves before six o'clock; after which they have a day's work to perform for their lords; and all this, for the most part, with nothing to subsist on but coarse dry bread and water. And yet, we have it from authority which we cannot question, that "there is not a happier, healthier, or more contented human being on earth, than the Polish peasant.

"At day-break, ere the birds have begun to move on the branches where the dark night had put them to sleep, the air and the forest, the valley and the hill, echo with the joyous and innocent songs of the Polish peasant. At noon, when the sun's oppressive rays compel every animal to seek shelter under the shadow of a tree, a hedge, or a wall—when even shrubs and plants drop their fainting heads—the Polish peasant boldly encounters the burning heat, and singing again his blithesome song, announces to the world that he is neither fatigued nor unhappy. And at evening, when those who have done nothing during the day, feel weary or sink in ennui; or sitting at their luxurious tables, or in their arm chairs, gape with impatience at the slow approach of the hour of sleep, even then, the same glad song of the peasant is heard."

The wandering Tartars, who are among the healthiest, and in their own way the happiest of men, are early risers. So it is indeed among many other simple but healthful tribes of men. The Circassians are so much in the habit of early rising, that they are accustomed to attack their enemies before sunrise, and often indeed ere the appearance of the sun's first rays. These too in respect to strength and beauty are well known to be nature's special favorites.

To show that a large proportion of such men as we have mentioned, did, in truth, reach a very advanced age, we have collected the following twelve of those whose ages could be ascertained.

Paley,	63	Frederic,	75	Lord Coke,	85
Washington,	68	Baxter,	76	Wesley,	88
Matthew Hale,	68	Buffon,	81	Stanislaus,	89
Priestly,	71	Franklin,	84	Cornaro,	100

The average duration, therefore, of the lives of these twelve distinguished men, was no less than seventy-nine. Napoleon, it is true, whom we have omitted, did not reach a very advanced age, and Sobieski fell somewhat short of seventy.

Economy.

It has been far more common for writers to dwell on the economy of early rising, than on its tendency to promote cheerfulness, health and happiness. We will not say that we have no authors, even in morals, who cannot rest till their minds and hearts linger around the shades of dollars and cents; but we will say, that by far too many of this class of men give sad evidence that thoughts of this kind are uppermost.

And yet they have made some sad mistakes in this matter. They have told us, it may be, how many actual years of time were lost to the individual who, during the whole of a long life, should lie in bed one hour, or two hours, or three hours in the morning. Now it is very possible, that the individual who rises two hours earlier, may perform no more labor than he who sleeps during the same time. For if he who rises two hours earlier in the morning, goes to bed also two hours earlier in the evening than his neighbor, is it not obvious that the one is out of bed as many hours as the other? And on the presumption that both are equally active, where is the gain from early rising? There *is* gain, we acknowledge; and we are anxious to make the most of it; but is it correct to say that in such a case as this, the early riser extends his life beyond that of the other, at the rate of two whole hours for every day? Obviously not. Let us be careful, then, how far we avail ourselves of jesuitism in the inculcation of what we believe to be truth. Let us not attempt to promote a cause which we love even more than our own lives, by measures whose basis is not truth but error.

But what becomes, then, of the so much boasted economy of early rising? we shall probably be asked. We have already shown, in another place, that it consists partly in a saving of health. If a feverish state is induced by late sitting up in the evening, and if this febrile state is avoided by early rising and early retiring, then the gain in this point of view is incalculably great.

It may be asked, however, if this febrile state does not come on when we have been up and active a certain number of hours, whether we begin with the rising of the sun or two hours later. In other words, why should not the person who rises at four in the morning become as feverish at eight in the afternoon, when he has been active

sixteen hours, as he becomes at ten in the evening, who did not get up till six?

Our reply is, that though we may not be able to state clearly every reason why, yet the fact is obvious. The Creator seems to have kindly adapted the day to action and the night to repose; and he who conforms, with the most exactness to his established laws, whether natural or revealed, must—other things being equal—inevitably be the most healthy and happy. Hence we might infer a necessity of sleeping about an equal number of hours before and after midnight. And what we infer, in this case, is confirmed by almost universal experience.

The same view is also strengthened by analogy. There are few instances among the lower animal tribes, of late retiring or late rising. They retire with the sun, and either rise with it, or long before it. The most striking exceptions to this rule are to be found among the more indolent and sluggish; as the marmot, the bear, the woodchuck, and the swine. Should these pages arrest the eye of any of those who sleep late in the morning, it may be worth a passing thought whether they will continue to assimilate themselves to the most ugly and loathsome animals; or whether it will not be advisable to conform more nearly to the habits, in this respect, of those species which are the most beautiful and sprightly and intelligent.

Another reason why a person becomes less feverish, or in other respects injured or diseased, in a given number of hours, when he has risen early, is, that he is more likely to get before and *drive his business*, instead of letting that drive *him;* and thus he is not likely to be in a hurry or be fretted with his employment. Everything proceeds, through the whole day, with comparative quiet, ease, and facility; and night comes without finding his mind dis-

tracted, or his body over-fatigued. All this difference, however, will be mystery to him who has never tasted the pleasures or benefits which we have mentioned as connected with and flowing from early rising.

This consideration presents two reasons why it is economical to rise early. First, it is for our health; and good health is good economy. Secondly, it is a saving, directly, of both money and time.

Again: he who uses the artificial light of lamps, candles, &c. in the evening, and then lies in bed the next morning after the sun's light is sufficiently strong to enable him to work by it, is, in two more points of view, wanting in sound economy. Dr. Franklin illustrated one of these points, in his usual good-natured manner, by attempting to prove to the dissipated inhabitants of Paris, who lay in bed long after sunrise, that the sun gave light as soon as it appeared above the horizon. He went so far as to make a calculation—it was rather an amusing one—to show how much the whole city of Paris would save in a single year by using sunshine instead of candles; viz, $17,774,000.

Now Dr. Franklin's estimates, notwithstanding the playful manner in which they were presented, contain much truth; of just such sober truth, too, as would be applicable, at the present time, to a large proportion of the citizens of the United States. We have very little doubt that four out of five of our whole population, sleep more or less, or at least doze, after the sun's light in the morning has become strong enough to enable them to labor. And just so far as this is the fact, and in so far as these same persons use artificial light in the evening, in exactly the same proportion would the estimates of Dr. Franklin be applicable to their own circumstances.

It is not the mere loss of oil, however—though this was robably the only item which entered into the foregoing

calculation by Dr. Franklin; there is a greater loss still by using artificial lights, especially in the evening, in the injury done to the eye, and through this medium to the stomach.

The position of much of our artificial light is such that the rays strike the eye directly; whereas during the greater part of the hours in which the sun is above the horizon, the eyelids are between the sun and the more delicate apparatus of vision. Hence it is, in part, that the light of lamps and candles and fires injures the eyes more than the light of the sun does. The artificial heat of our rooms, however, added to the artificial light, is very injurious to the delicate organ of vision. And both these causes produce more injury to the eye in the evening, when our bodies are fatigued and a slight degree of fever is present, than in the morning, after we are rested and refreshed with sleep.

One caution is necessary, it is true, to those who use fires, lamps and candles in the morning before day; which is, not to expose the eye too suddenly after we rise to a very strong light. We should come to the light gradually. If we do not, the eye may be seriously injured; and the stomach, through sympathy with the eye, may also suffer. We have known a student who was subject to nausea, and sometimes vomiting, if he at once lighted his lamp on rising from his bed before daylight. This sympathy between the eye and the stomach has been very little considered. Perhaps more of our modern dyspepsia is owing to the wretched print of our modern books—school books as well as others—and to the use of lamps and candles, than most of us have ever supposed.

Having thus shown, directly and indirectly, the more prominent sources of injury from sitting up late in the evening, and rising late in the morning, and having

represented as plainly as we could the vast advantages, in point of real economy, which result from rising early, there remains on this part of our subject, but one thing more to be considered.

We have shown that there is a fallacy in some of the estimates which have been made of the waste of time involved by lying in bed late. That there is, however, a great deal of time wasted in this manner, we have never doubted for one moment. But admitting time to be really wasted in sleep, how MUCH do we waste?

An extended reply to this question would involve a full discussion of the whole subject of sleep—its uses and abuses. Upon such a discussion, we cannot of course now enter. We can only say, that those writers who make the most liberal allowance, are very generally agreed, that most adults sleep about two hours longer than the wants of their nature demand.

Whether these two hours are wasted before midnight or afterward, makes little difference as to our present purpose. If it be admitted that an average amount of time, equal to two hours in every twenty-four, is really wasted by each adult, we then have good and substantial data on which to found the following estimates:

Two hours a day, from the age of twenty to fifty, that is, for a period of thirty years, amount to 21,914 hours, equal to two and a half whole years of human life; or more than three and a half years, if we consider as a part of real life, our waking hours only. But three years and a half, or even two and a half, subtracted from the meridian of human life, is by no means a trifling loss.

But let us proceed a step further. The whole population of the United States must be at least fifteen millions. Suppose only half of these to reach fifty years of age. Yet two years and a half deducted from each of 7,500,000

individuals, amount to 18,750,000 years of a life of the shortness of which almost every one is complaining. To superior beings, must not these our complaints, arising as they do, appear childish, or even ridiculous?

It seems almost unnecessary, in a country where every body understands the rules of common arithmetic, to compute the value of this mighty aggregate of wasted time. Every one must see, that a loss of two years and a half of active life is no trifle. Can its value be less, upon the average, even when we consider the low price of female labor, than $250? But this is a loss to the present generation of $750,000,000.

We will say nothing of the valuable uses to which such an amount either of wasted time or money might be applied. It is sufficient if we have made it apparent that an enormous waste does exist. If our estimate were even twice as high as it should be—though we believe it too low, rather than too high—the subject should lead us to reflection, and induce us to make the inquiry, whether by our own example, we may not be contributing to swell this mighty aggregate of wasted property, and in that way becoming, in a greater or less degree, responsible for the consequences.

Means of securing the habit of Early Rising.

Four things are indispensable to those who would form, for the first time, the habit of early rising.

First—a thorough conviction of its importance.—If arguments like the foregoing, have failed fully to convince an individual that a change of habits will make him happier, healthier, and more prosperous in his pecuniary concerns, then it seems to us in vain for him to talk of the importance of such a habit, or of the means of acquiring it.

Secondly—a strong will, and a fixed determination to succeed.—No lounger will ever become, permanently and habitually, an early riser, till he has a fixed determination to be so. He who wavers continually, sometimes rising early, at others yielding to temptation, and practically saying, "A little more sleep—a little more slumber," just this once, will never reach the goal, nor secure the prize. There must be a will like that of Luther, when he resolved to go to a certain place, though his way were obstructed by wicked men and infernal spirits thick as the tiles on the tops of the houses.

There are some persons who cannot rise, or think they cannot, without the immediate interposition of some pleasurable motive. While the will is still weak, and the temptation and inclination to indulgence in our old habits still strong, something of this kind may be useful. A pleasant morning walk, or familiar conversation, or reading exercise with a choice friend, joined to a conviction of the importance of the practice, may often prove a motive of sufficient strength to enable us to rise early. If, however, the motive be very strong, the sleep will be less sound and satisfying. Many people are able—perhaps the most of us might be—to rise at nearly the precise hour they please, provided they fix it strongly on their minds, at lying down, that they will do so. But sleep, in such cases, as we have already said, is more or less unsound; and no excitement of this kind should be used any longer than till the spell which had hitherto bound us to our couches, is completely dissolved.

Persons in whom this habit of early rising is firmly fixed, find no difficulty in awaking at their appointed hour, provided they go to bed in good season; for this, after all, is the key to success in our efforts. Stanislaus I. of Po-

land, who retired exactly at nine, as we have already said, always slept soundly, and always awoke precisely at three.

We are of those who believe that all children are naturally early risers; and that no motive of an extraordinary nature is necessary to arouse them at three or four o'clock, provided they retire early enough, and have already slept as much as their natures require, which is certainly a great deal. We have no objection to their going abroad with the parent, in his morning walks; but a promise beforehand that they may do so, is a less efficient and permanent motive than the more natural ones—the fond caress, kind looks and words, and the morning congratulation of their parents.

Much depends, after all—so far as concerns the formation of a habit of early rising in childhood—upon the mother. It is almost in vain that the father rise betimes, and prepare for the reception of his little prattlers, provided the soul of the mother is still confined in its sleeping tenement. She, too, must grace the scene. Whether it be the cheerful fireside, or nature's more spacious parlor, the verdant lawn, the mother's presence is equally important, and we might add, equally indispensable.

In regard to the extent and nature of their influence, mothers seem to me too generally insensible. It is seldom, indeed, that a mother will assent to the proposition that the early rising of her household depends almost wholly upon her. And yet every one who has observed how feeble, and often how abortive the father's efforts are, when they are not seconded by those of the mother, must, it seems to us, be constrained to admit its correctness.

Thirdly—a fixed habit of going to bed early.—Perhaps this point has been made sufficiently clear, in another place; but it was necessary to advert to it here. No person will long rise early, who does not retire early; and

we ought not to expect it. Nature must have her rights. We must have good and sound sleep, in sufficient quantity, or we shall ultimately suffer. It is true, as we have already insisted, that the bulk of mankind—especially of adults—sleep too much. Still there are those who continue to yield to the temptation of sitting up till eleven or twelve o'clock, and yet endeavor to rise at four—and perhaps reproach themselves that they do not. Let such persons beware. If they expect to form, with safety, a habit of rising at three or four, let them by all means be in bed by eight or nine; or their constitutional vigor will ere long be impaired.

Many persons plead the pleasures of the winter evening fireside; and gravely tell us that to go to bed by nine o'clock in the evening, when the room is warm, and the world without doors mostly quiet, would be to deprive themselves of two or three of the sweetest social hours of their whole lives.

But have these persons ever considered that the two hours which intervene between four and six o'clock in the morning, are fully as quiet as those between nine and eleven of the evening? Is not the individual, refreshed by sleep, in even better spirits? Is not the mind clearer? Are not the social feelings more awake? May not the room be made just as warm and comfortable? The answer to all these queries must unquestionably be such as to confirm beyond debate the correctness of the views we have here presented.

A fourth means of securing the habit of early rising, is a proper state of the system—body and mind—when we lie down at evening.

Dr. Franklin, in his usual common-sense manner, has attempted to prove, that in order to have pleasant dreams it is necessary to retire, at night, with a good conscience.

His remarks on the importance of mental quiet are little, if at all, less applicable to the subject of early rising. There cannot be a greater mistake, than to expect sound and refreshing sleep, when we retire with either the mind or the body in an agitated or disturbed state.

There are multitudes, however, who do not hesitate to go at once from hard study, or hard labor of the body—at least of the stomach—to their couches to seek immediate repose. It is difficult to say, whether they suffer most when the boon is, in these cases, for some hours denied them, or when they are disturbed or occasionally aroused by dismal dreams, painfully convulsive movements, or distressing nightmare. In either case, though they may have retired at a seasonable hour, the morning usually comes before they are ready for it; and if it brings with it no headache or other positive disease, it seldom brings with it that degree of resolution which is necessary to enable us to overcome the repugnance which we feel to early rising. This is especially true of the winter, when the weather is not only cold, but we are obliged to rise in a cold room. Thousands in these circumstances will be likely to yield to temptation and slumber longer, who, were they to retire in a quiet state of mind and body, would break the chains of habit and indolence.

We have referred to the cold as having an influence to dissuade the indolent from early rising. Now it has often occurred to us that they make a sad mistake, who think they cannot possibly get up at four, but who are compelled, partly by the force of conscience, and partly by necessity, to rise at six. For every one who has reflected on the subject, knows that it is usually quite as cold at six, as at four; perhaps a little colder. What, then, do we gain in this respect by lying two hours longer?

In regard to the body, in particular, it should be remarked, that while it is both unphilosophical and unreasonable to go to bed excessively fatigued, it is much more unreasonable to do so with a heavy load imposed on the stomach. Many laboring men eat heavy suppers at the close of their day's work, and then retire immediately; and if they do not, in this way, subject themselves to all the immediate horrors which we have mentioned as accompanying an unquiet state of mind—of which there is very great danger—they will, at least, awake with bad feelings, which they mistake for a want of sufficient sleep. How many a time has not only the farmer, but the man of almost every other avocation, after eating his heavy suppers and going immediately to bed, awaked and attempted to rise betimes, in vain. We do not mean to say, that there was any physical impossibility in the case; but there was such a strange state of feeling, and such a propensity to "a little more slumber," as overcame every virtuous resolution which had been previously formed, and which, perhaps, had been partly revived at the moment of his awaking. And he who for once indulges himself in lying a little longer, under these circumstances, is apt to do so again and again, till, at last, he becomes what he was before. Or, like the man in the gospel, his unclean house, though emptied swept and garnished, becomes, by an injudicious return, and ill-assorted company, infinitely worse than before.

There is no safety in this unpleasant, but very common case, but in springing out of bed the instant we wake. Linger not a moment on the confines of Sodom, but force yourselves in an instant upon your feet. If you have not had sleep enough, retire a little earlier than usual the following evening; and if you have retired in an improper state of body or mind, see that you do so no more.

Instead of retiring while the body, or the stomach, or the mind, are unfit for it, it were far better to spend an hour or two in pleasant, amusing conversation, or in some light recreation. Perhaps there is no place which will furnish a greater variety of pleasures and amusement of the right kind, than the domestic circle. As another preparation still for quiet and refreshing sleep and a disposition to rise early, we might mention—and we now speak as philosophers merely, and not as christians—those moral and religious duties which have been so often enjoined on families, and which have, to a greater or less extent, and in some form or other, been so early and so extensively practised.

In short, let us view the subject in whatever light we may, if we are true to ourselves and to our own nature, it is impossible to resist the conclusion, that the pleasures, the cheerfulness, the pecuniary prosperity, the health, the longevity, and the intellectual and social happiness of man, depend, in no small degree, on the habit of early rising.

MAY-FLOWERS.

BY D. H. HOWARD.

May is proverbially the month of flowers. The comparison has undoubtedly been made rather with the months which precede than with those which follow it; and in a milder climate than ours. The summer months afford a more abundant variety of flowers than the spring; but the contrast with the stormy season which has just passed, which makes the spring and its flowers so grateful, is wanting to them.

Our New England May has not received, nor justly deserved the praises bestowed upon the vernal months of classic Italy. Ours is an inconstant climate, and our spring is peculiarly so; seeming to delight in intermingling the alternate extremes of summer and winter. But we *have* bright days, and bright flowers, even in May, though they are few. We thence learn to value them more highly. They are our diamonds, which we only gather here and there, in the sand of the river's bed.

Our flowering season commences about the middle of April—oftener later than earlier; and but a small number of flowers are usually to be obtained, even at the commencement of May. Still, however, the course of the season affords so great a variety that many must be passed lightly over, and we must select the most deserving of a

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place in our catalogue, if such a distinction can be made, in a creation which is all so beautiful as that of the flowers.

We cannot here speak of the snow-drop, the cowslip, the primrose and the daisy, which adorn the green meadows of Old England long before the snow and ice have melted from ours. Our gardens may contain them, stranger nurslings, but our soil knows them not. We may remark here, however, in order to be well understood, that English names have been given to American plants, from imagined resemblance to their original prototypes. So dear to our fathers was everything connected with their home, that they endeavored to find, or to make, everywhere—with the flowers, among the rest—associations and remembrances of their native, in their adopted land. Hence many of the duplicate names which perplex the botanical student, meaning one thing across the water, and another thing this side. But let us return to our flowers.

The Violet, justly one of the poets' favorites, is among the earliest and most beautiful gifts of spring. Our meadows furnish a great variety, at this season. All our native species, we believe, are also exclusively American. The garden violet, (*Viola tricolor*,) called also heartsease, ladies-delight, pansy, &c., may be better known than any wild species; though certainly it is not more beautiful, notwithstanding its great variety of hues. The simple and delicate wild violet, with its purple veins and fringes, will be more charming to any mind that knows how to find beauty in simplicity.

The violet flower consists of five petals, somewhat twisted, and enclosed by five green calyx leaves, behind which projects a spur or nectary—a receptacle of honey. Within the flower will be discovered five short stamens,

and one pistil, whence it finds a place in the fifth class, Pentandria, and the first order, Monogynia. Its fruit is a dry three-valved capsule, or seed-vessel.

Prof. Rennie mentions of the violet, that it possesses, like the balsamine, the power of throwing its seeds to a distance, (though by a different mechanism.) He found the seeds of the heartsease, (garden violet,) thrown to the distance of two feet. The valves of the capsule, when they open, exhibit a tendency to roll up—increased, probably by the heat of the sun's rays; and their hard edges, pressing upon the smooth seeds which lie within their cavities, force them out with violence.

The *Viola cucullata*, or violet with rolled up leaves,—(that is their form when new grown,)—is one of our most common species. It bears a fine, large blue flower, and grows luxuriantly in meadows, and by the side of small brooks. The leaves are heart-shaped, with long, slender footstalks, springing together with those of the flowers, immediately from the root. After the flowering season, the leaves extend from the size of a dollar to three or four times as large, so that the plant is hardly recognizable for what it was a month before. But this is not peculiar to the violets, and is much more strikingly exhibited in some other plants.

Akin to this, but smaller, is another violet, (*Viola ovata*,) with blue or rather purple flowers, growing in dry pastures. We have observed in this violet, a singular phenomenon, which is ascribed by Prof. Nuttall, if we remember rightly, to most or all of our violets. During the summer, after the regular flowering season is past, they continue to produce and ripen their seeds *without flowering*. The apetalous flower is produced, and perfected, apparently, in the form of a bud, but falls away, without ever expanding.

Our meadows are adorned early in spring, with several species of white violets; principally *Viola blanda*, and *Viola lanceolata*—possibly varieties of each other. They are fragrant, the former with round and bright green, the other with long and rather slender leaves. The flowers are nodding, like most violets, and veined finely with purple within.

A larger and more beautiful species is the yellow wood violet—*Viola pubescens* of the botanist. The flower is yellow, with dark purple veins. The stem is stout, and the leaves large and hairy, to which latter circumstance its Latin name is due. We have seen it abundant in the western part of the state, particularly in woods.

But the most singular, if not the most beautiful, of our violets, is the bird's-foot, (*Viola pedata.*) The name suggests the form of the leaves, which, unlike those of most other violets, are cleft quite to the stem into slender strips, like fingers, or bird's toes. They are pale green, and all radical, or rising from the root. The flowers are large, abundant, and pale blue, with yellow in the centre, but without any veins or stripes. Its favorite soil is dry and sandy. Accordingly, it abounds on the barren uplands which nourish the pine and the wild lupine. It deserves a place in the ornamental garden, where it would show to great advantage.

We have said the violets were among our earliest flowers. Yet, before the first violet's blue eye is open, the fields, in some places, begin to be scattered with the tender flowers of the *Houstonia cærulea*, looking, as some botanist has graphically remarked, like handfuls of pale premature lilac flowers scattered over the ground. The Latin adjective *cærulea*, indicates its bluish tint, and the other part of the name (*Houstonia*) the discoverer. The flower is mostly, however, white, with a yellow

centre. Its corolla is monopetalous (formed of one leaf or petal) and tubular, but spreading out four-cleft or cross-form, at top. It is found in the fourth class, Tetrandria, having four stamens, which are so short that the tube of the flower must be torn open to examine them.

At the same time with the violet blooms the *Anemone*—the beautiful *Wind-flower*—once fabled to bloom only when the wind blows upon it. We have two species—the *Anemone nemorosa*, or wood anemone, which we believe some call snow-drop, and some even violet—and the *A. thalictroides*, taking its name from another plant whose leaves it resembles. The former is the more abundant in this vicinity, being found, indeed, in almost every moist wood and meadow-side. Its petals are five or six, delicately shaded with red; each plant bearing only a single flower. The Anemone thalictroides has from six to a dozen white petals, and numerous flowers on a stem. It is more showy, and hardly less delicate, than the former. Both species may be found on Mount Auburn, as may indeed, very many of the spring flowers we shall mention. The anemone belongs to the class Polyandria, order Polygynia, and is one of those which are destitute of a calyx. Some of the plants of this class and order are decidedly poisonous; and none, probably, are altogether wholesome.

Closely allied to the anemone, and by some placed in the same genus, is the *Hepatica*, a very early and most delicate blue flower, with six petals, and a little ways below, an involucre of three leaves, which is called by some a calyx. The proper leaves are radical, three-lobed, as though the three leafets of a clover leaf were cemented together by their edges, in the position in which they grow. The old leaves remain green all winter, and the new ones do not sprout till after the flowers. It is found

in shady woods, and called liverwort, and liverleaf; by the former of which names several other plants are known.

The Cowslip, so called here, (*Caltha palustris*,) gathered early in our meadows, as an esculent, belongs, with the last, to the same class as the anemone. In England, it is known by the name of marsh-marygold; for the true cowslip of that country, (Primula,) is a very different thing. The large yellow flowers of the American cowslip, though not very elegant, form a showy ornament of our meadows, at a time when there is little else to adorn them.

We need not wait long after the opening of May, to find on the cliffs and hill-tops, the scarlet Columbine, (*Aquilegia canadensis*,)—or canadian, so called from one of the countries it inhabits. It constitutes an elegant drapery to the almost barren rock—being delicate both in foliage and flower. It is more slender in all its parts than the blue columbine of the gardens. The five petals, (between which arise five calyx leaves,) are each elongated into a slender horn, which, in the cultivated species, is incurved, but strait in the wild or scarlet columbine, and containing at the bottom a quantity of honey, which the bees probably are unable to reach. Its class and order are Polyandria Polygynia.

But the same hills which are festooned with the columbine are not unfrequently long before whitened with the vernal saxirage, which, like that, even in the rude climate of an early spring, seems to prefer the hill-top to the vale.

The species of maple bloom principally in the spring,—several in May. Among the latter is the Sugar Maple, (*Acer Saccharinum*;) but this, like most of the species, produces flowers of a dull greenish color. To this, however, the red maple (*Acer rubrum*) is an exception; for early in April, its branches are decorated with clusters of

crimson blossoms; and before the leaves have grown, the tree is once again crimson with the ripe seeds; which falling, take root and grow the same season.

With the Buttercup, called by the botanist *Ranunculus*, everybody is familiar—and with the glossy lustre of its yellow petals. There are numerous species, which probably are not generally distinguished apart, as they much resemble each other, both in their leaves and flowers. In about all the species is found, on the root of each petal, a small scale—a mark which may serve to distinguish this genus. The leaves contain an acrid juice, capable of producing blisters.

By old walls, and in other waste places, may be found the yellow Celandine, (*Chelidonium majus*,) early in the month, throughout which it continues to make a showy display, in these situations. It has a near affinity with the poppy, and is filled with a milky juice of a bright orange color, staining deeply. It is supposed to be a naturalized exotic, and not a native plant, though a very hardy one.

Several species of *Trillium* are early vernal plants of considerable beauty. They are all inhabitants of moist ground, in shady woods. The most common species is *T. erectum*, of which there are several varieties, arising from variation of color, there being those with white, green, yellow and dark purple flowers. The leaves are three, forming a whorl, of a broad rhomboidal form. In the centre rises the flower stalk, with a single flower, of three petals, a three-leaved calyx, six stamens, and three styles. The regular ternate arrangement of the flowers and foliage is unequalled, except by the quarternate herb Paris of Europe.

Another species is the *cernuum*, of more slender form, and with a white flower, which is bent down, and con-

cealed under the leaves from whose bosom it arises. The *pictum*, or painted Trillium, is rather similar to the last, but more showy and delicately stained with red. But none of these plants are possessed of any agreeable odor, and their roots are said to be acrid and poisonous.

Let us now, for a while, pass from herbs to trees. The *Cornus florida*, a small tree, called in common language Boxwood, and Dogwood, (but it is not the poison dogwood,) makes a fine show in the woods, this month. The proper flowers are small, four-cleft, with four stamens; but set in small heads or bunches, around which are involucres of four large white leaves, to which the display is owing, and which the superficial or unscientific observer would not doubt were the real petals. The wood is hard, and when of the largest growth, useful in working.

The *Azalea nudiflora* (naked-flowered,) is one of our most splendid flowering shrubs. It is abundant in some of our swamps and thickets, bearing blossoms of almost every shade, from pale pink to crimson or scarlet. It is well known, where it grows, by the names of Swamp-pink, Swamp-honeysuckle, &c. It is very fragrant, with an odor strongly resembling that of the pink; whence its name. The flower contains considerable honey, and is viscid, or sticky without. It is tubular, spreading into five divisions, with five long slender stamens, and blooming before the leaves are grown. It rises from five to ten feet in height. There are several other species among us, some of them summer flowers, but none more elegant than this.

A singular fact is related by an ancient historian, and confirmed by some modern travellers, respecting the *Azalea Pontica*, growing in Turkey; viz, that its honey is poisonous, producing a species of intoxication or delirium in those who partake of it.

An earlier, and smaller flowering shrub, nearly allied to the *Azalea*, is the *Rhodora*. It has a handsome, purplish flower, ranking in the tenth class. It has but three petals, instead of five, the usual number in flowers with five or ten stamens; but one of them is of the breadth of three of the others, to make up, apparently, for the deficiency in number. The walks of Mount Auburn, if we mistake not, are ornamented in a few places, with this shrub.

We may here also join the useful with the beautiful; for the flower of the invaluable apple, is a May-flower. It is one of those called rosaceous—many of which are trees—and affording us some of our best and most wholesome fruits, as the pear, the strawberry, raspberry, &c., besides the apple. All this race produce flowers with five petals, as the rose does in its native or wild state, and usually a large number of stamens (above twenty,) growing from the calyx, which does not fall away, but remains more or less perfect with the fruit. These are the marks of the artificial class Icosandria, which is principally made up of rosaceous plants. But we need not stop to describe the beauty or the fragrance of the apple flower. They are well known. The flower is worthy of its fruit. We pass on to mention a few other verna rosaceous plants.

The bloom of the thorn tree, (*Cratægus*,) which is of this family, is beautiful, though rather short-lived. We can hardly imagine that anything could afford a more delightful appearance, at this season, than the hedges, robed in green, and white with flowers, which form the enclosures of fields in England, where their blossoms are significantly termed *May*. Our wild thorn trees are of different species from the English hedge thorn. The thorn bears re berries, called *haws*, whence the familiar

name hawthorn, applied to the thorn, of the hedges (*Cratægus oxyacantha.*)

The white flowers of the shad-bush, or June-berry, (*Aronia botryapium*) will usually be found early enough to form a portion of the May morning bouquet, to which they will form an agreeable addition, as they exhale a pleasant fragrance. Like many early flowers, they appear before the leaves. It bears an edible berry, ripening in June. It is a slender shrub, eight to twelve feet in height.

The common wild strawberry is, or would be, if taken care of, a valuable fruit, exceeding the commonly cultivated species in sweetness, and under favorable circumstances, equalling them in size. The progress of agriculture, however, in our thick-settled state at least, is making rapid inroads upon their native growth. It would be worth while for the horticulturist to take it under his protection, we think; even though it should not, for a long time, become extinct, as at least it threatens to do.

Much like the strawberry, but differing in its yellow flowers, and absence of fruit, is the *Potentilla*. The species *canadensis*, especially, is very common, as well as one of the very earliest of our spring flowers; sending its creeping stems over whole pastures, which it enlivens with its bloom. Its leaves are composed of five leafets, whence the familiar name of five-finger, by which it is known. A larger and more elegant species, also blossoming in May, is the *P. anserina*, which is rather rare, being pretty much confined to the sea-shore.

We must also give the sweet Lily of the valley a place among our May-flowers. It is a native of the southern, but not of the northern states, though a favorite in northern gardens. Its Latin name is *Convallaria maialis*. *Convallaria* signifies a valley plant, and the adjective,

designating the species, (*màialis*) refers to the month in which it flowers. It is one of the smaller examples of those plants called, in the widest sense of that term, *liliaceous*. Like most or all of them, it has a corolla of six divisions and six stamens. The flowers of the lily of the valley are small, white and delicate, growing at the summit of the single radical flower stalk or scape.

We have a number of wild, and not inelegant species of this plant. One of them, at least, is familiar to many, under the name of Solomon's seal, which flowers in June. This and several other species, are several feet in height; whereas the lily of the valley is only a few inches. We have seen one, in the western part of the state, which we supposed to be *Convallaria multiflora*, which was from three to four feet high—with half a dozen or more florets in each axil.

The Convallaria bifolia is a pretty and small plant, blossoming in May. It has two shining heart-shaped leaves (thence called *bifolia*, or two-leaved) growing near the ground, and a dense cluster of sweet, white flowers. It differs from all the other species in having only four stamens, and a four-cleft corolla. The berries of this and the Solomon's seal—perhaps of some other species—are mottled green and red before ripening, and when full ripe, red and acid.

Besides the Convallarias, the spring affords several other more strictly liliaceous flowers. The most superb of them all is the *Erythronium Americum*, improperly styled Dog-tooth violet. Its six petals and stamens indicate its affinity with the lilies. Each plant bears a single nodding yellow flower, rising from between two reddish veined leaves. It is the American rival of the crocus, a flower which, in the old country, is an essential element of every idea or association of spring. Unfortunately,

our beautiful Erythronium is too little known, or too rare, to be appreciated, and to become, as it deserves, like the crocus, a watchword and an emblem of spring.

Two species of *Uvularia* or Bellwort, also of the liliaceous family, adorn our woods in May. The most remarkable is the *U. perfoliata*, whose very smooth leaves are actually perforated by the slender stalk. The flower is drooping, often half-concealed among the upper leaves, of a greenish yellow color, with six short stamens. Its bruised herbage is a reputed external application for the cure of poisons ; and we have also seen the *Uvularia grandiflora* of Pennsylvania,—a plant very similar to this,—mentioned as possessed of similar properties.

We must not forget the elegant and early *Polygala pauciflora*, known by the name of flowering Wintergreen. It is a wood flower, spreading by its roots, and covering considerable portions of ground. It is one of the most interesting of the genus Polygala, most of which are late summer flowers. The blossoms are red, three or four of them crowning the little stalk, just above a tuft of small oval leaves. The dried flowers of the Polygala, notwithstanding the delicacy of their colors, preserve them with almost living freshness, when dried.

The *Trientalis* is another plant which is probably very little known. It is remarkable to the botanist as being the only flower of the seventh class, (for it has seven stamens, and the same number of petals) found native in our soil ; and the only other example we have growing with us is the horse-chesnut. The leaves of the Trientalis are slender, growing in a whorl or ring, from the centre of which arise several flower stalks. The blossom is of a beautiful white. We have heard a florist remark of the Camellia, that it produced the most perfect white

flower; yet we doubt if it is exceeded by this delicate wood-flower. It begins to blossom about the middle of May, in shady places, especially pine woods.

It is probably not generally known that we have several native species of Geranium. In most minds, that name is associated only with a class of foreign plants, principally brought from the Cape of Good Hope, some of which are remarkable for their fragrance. Our most common species, however, the *Geranium maculatum*, is destitute of that property. It is a plant one or two feet in height, with large, pale red or bluish flowers, and of rather an elegant appearance. The leaves bear much resemblance to those of the common kinds of buttercups; though the flowers are widely different. It is common in low rich land.

We will just mention the *Euchroma coccinea*, or painted cup, (*Euchroma*, from the Greek, meaning beautiful color, and *coccinea*, meaning scarlet in the same language,) which is found in the class Didynamia, and order Angiospermia. It presents a beautiful example of a fine scarlet color; though it turns black in drying. It is remarkable that, in this instance, it is not the blossom itself, but the leaves surrounding and enclosing it, called bracts, in which this elegant color is situated.

The *Epigæa repens*, a small creeping plant, with a woody stem, and bearing early in May a fragrant pink flower, is said by some one to have been the first flower discovered by our Pilgrim fathers, after having spent their first tedious winter on this then inhospitable shore, and by them called the *May-flower*. Bigelow, in his "Plants," gives it the name of ground laurel. We believe it is somewhat rare.

Menyanthes trifoliata, is the name of an elegant plant known by the vulgar name of Buck-bean, growing in

boggy situations, in the northern part of the United States. The flower is of a reddish white color, cleft in five divisions, and with five stamens. It flowers about the middle of May, in New England. The root is creeping, sending up flowering branches from the joints. The leaves are in threes, whence the name *trifoliata.*

Among the numerous flowers which enliven the latter part of this month, is the Barberry, whose yellow flower is strongly fragrant, (to some disagreeable,) but more peculiarly remarkable for the great irritability of its stamens, which, on being merely touched by the point of a needle at their bases, spring suddenly against the pistil.

Another beautiful May flower which deserves our notice is the *Cypripedium,* or Lady's slipper, of which, though there are several species, we shall notice only the more common one, *C. acanle.* This is a red flower, one of whose petals is largely inflated, so as to have been supposed to resemble a shoe or slipper. It would, however, make a much better purse than slipper; for it would hold at least gold enough to last the traveller on a journey to the far West; while nobody but a fairy could wear it for a shoe. The flower stalk, bearing a single pendulous flower, rises from between two large green, radical leaves. It is only to be found in deep shades.

Of the same class with the last, Gynandria, also of the natural family of the *orchideæ,* a singular race of plants, and containing many beautiful ones, is the elegant *Arethusa,* found here and there in wet places. Both the florist and the botanist will find it highly interesting. It is said, however, to be not very common.

Before the end of May, will probably be found the beautiful perennial wild Lupine, (*Lupinus perennis,*) in sandy lands. The leaves are digitate, composed of eight or ten leafets in a terminal whorl, with a fine silky down.

The flowers are blue or purple, in long spikes, and succeeded by thick hard pods.

The wild Flag, (*Iris versicolor*,) will now begin to adorn our meadows. Several cultivated species of the *Iris* are well known, and some are highly prized by the florist; nor is this wild species inferior to many of them. It is not destitute of fragrance, and its curious variegated corolla, (which seems to have procured for it the singular name of snake lily,) makes it an interesting object of study. Three of the petals are broad, and striped with purple and yellow; three narrow, and erect. The three spreading stigmas are perfectly petal-like, and within the concavities of their under sides lie the three corresponding stamens.

Of the same family is the *Sisyrinchium anceps*, or blue Star-grass of the meadows, and its lustrous blue flowers often make them appear azure at a considerable distance. It is a very delicate grass-like plant, with bluish green herbage, and six-parted flowers supported by slender peduncles growing from a flat sheath, and succeeded by globular capsules.

While these two plants tinge the meadows, the *Hypoxis erecta* strews the fields and woods with yellow stars. This plant is not distinguishable from a grass, by its leaves, when not in bloom; but its blossoms contribute, with buttercups and potentillas, to make the fields of May truly golden.

But our subject extends before us, while the limits to which we are confined are close in view. The Convallarias, the Ranunculuses, the Vacciniums and the Andromedas, and many smaller, and therefore, to the common eye, more insignificant plants, we must leave to the herbarium of the botanist, to whom nothing is mean, or

unworthy of notice, that reveals to him a link in the chain of nature.

Thus we have briefly described a few of the floral beauties of a New England spring. We have cared less to speak of the productions of the garden than of those of our own fields and woods, which are less known and less admired in proportion to their beauty. It seems to us that we ought at least to pay more regard to the gifts of Flora to our own soil than to forget to give them names—and leave to the botanist, along with this task, the pleasure of contemplating their beauties, which we may never have beheld. The plants now nameless and unsung, should be honored with the same, nay, with a nobler dignity, than those which have so long flourished in immortal verse, in the gardens of the olden bards. They should receive names worthy their beauty, their country, and the people whose treasure they are;—names to be found not merely in the books of the learned, but in the heart of every lover of nature, and in the song of some second and nobler Virgil, whom America may produce, to describe the forests, and fields, and gardens of a wider empire, and a happier people than the Roman knew.

SEMI-MONTHLY RECORD.

STATISTICS OF FLOWERS.

We think it may not be uninteresting to our readers to see here, some statistics of the seasons at which some of the more important trees and plants come into flower, which are described in the foregoing Tract. It will serve both to show the position which they occupy in the floral circle, and to illustrate our climate, as connected with the operations of vegetation; for they are derived from actual observations made in this vicinity and latitude for a few of the last years.

The Red Maple, in 1830, was in flower April 14; in 1831, April 13; 1832, April 21; 1833 and 1834, April 10.

Willow catkins appeared, 1829, April 14; 1830, fully blown April 14; 1831, April 2; 1832, April 10; 1833, March 29.

The Apple, in 1825, had begun to flower April 30—and the flowers were falling May 11th; 1826, begun to blossom May 10—in full bloom the 15th; 1829, in full bloom May 18th; 1830, in full bloom May 3; 1831, begun to blossom May 7—flowers fell off, 15th; 1832, a few flowers only on the trees May 15; 1833, May 7, some apple trees in bloom—in full flower the 12th; 1834, in full bloom May 18; 1835, trees in blossom, at least partially, May 22.

The Blue Violets (*Viola cucullata* and *ovata*,) come into flower, on an average, about the 20th of April; the bird's-foot violet, the first week in May; the yellow wood violet, the second week.

The Swamp Honeysuckle (*Azalea nudiflora*) flowers about the middle of May; in 1830, it was in full bloom May 15; in 1833, before the 20th; but in 1832, it did not flower till towards the close of the month.

The LILAC flowered in 1830, May 8; 1831, May 12; 1832, May 17; 1833, May 11; 1834, May 17; 1835, May 23.

The SHAD BUSH flowered in 1829, May 2; 1831, April 24; 1832, May 8; 1833, April 28.

The WILD GERANIUM was found in flower in 1830, May 10; 1833, May 16—usually found before the middle of the month.

COWSLIP in flower, 1830, April 19; 1831, in full bloom April 17; 1832, flowered April 25.

The FIVEFINGER (*Potentilla canadensis*) began to flower in 1826 and 1829, April 23; in 1827 and 1833, April 11; in 1831, April 13; 1832, April 21; 1834, found April 15.

The STRAWBERRY comes in flower a few days or a week later, and is hardly abundant till some time in May.

It should be remarked, that in proceeding southward, the same plant will be found regularly flowering earlier in the spring, and later to the northward; and the same remark will apply to the leafing of trees, on which we have subjoined here a few remarks. A series of observations on the flowering season of a large number of extensively spread plants, in all the latitudes in which they are found to grow, would be very interesting as a collection of facts, which might add much to the department of geographical botany. We do not know that any extended series of observations of this kind has been made.

The leafing of the trees also, is a phenomenon as interesting and important as that of their flowering. Use has been made of the leafing periods of trees, to fix the periods proper for planting different vegetables. Linnæus made examinations on this point, which were attended with some useful results. The Indians were accustomed to say that the time for planting their maize or corn was when the leaf of the white oak was grown as large as a squirrel's paw—which happens somewhere between the middle and end of May.

The wild gooseberry is the first of trees and shrubs which puts forth leaves in this climate; which happens about the first of April. The leaves of willows and the barberry, and several of the smaller shrubs, are put forth in April; but the most of our forest trees produce their leaves in May. The

oaks are the latest, and sometimes they are not in full leaf till some time in June. The birch leaf often appears in April; and the maple and walnut early in May.

ANCIENT RUINS IN AMERICA.—Late researches have shown the existence, in both North and South America, of remains of art far superior to anything formerly known or supposed to exist; and of which there is not the slightest vestige of tradition, or any clue to the discovery of facts concerning their constructers. Everything leads to the opinion, however, that they are of great antiquity; and all who have examined them have come to the belief that a comparatively civilized population must have existed on this continent prior to the ingress of those whom we are accustomed to consider as the aboriginals, but who, according to their own traditions, appear to have come from a distance, and gradually spread themselves over the country.

CHEMICAL NATURE OF GLASS.—Glass has usually been considered, without much actual inquiry into the subject, to be strictly a chemical combination of its ingredients, and in all respects a very perfect artificial compound. This, however, is far from being the truth. That the alkali in common glass of all kinds is in a very imperfect state of combination, many circumstances concur to evince. For example, Mr. Griffiths has shown, that if a small quantity either of flint-glass, or of plate-glass, be very finely pulverized in an agate mortar, then placed upon a piece of turmeric paper and moistened with a drop of pure water, strong indications of free alkali will be obtained; and that if the pulverization be very perfect, the alkali can be detected in other kinds of glass, containing far smaller quantities of it. This proves, that in whatever state of combination the alkali may be, it is still subject to the action of moisture. That flint-glass is by no means a compound resulting from very strong chemical affinities, and that the oxyde of lead which it contains is as imperfectly combined as the alkali, has been shown experimentally by Mr. Faraday,

and also appears from the tarnish which is produced on its surface by exposure to sulphuretted vapors, owing to the combination of sulphur with the lead. Glass which has long been exposed to the weather, frequently exhibits a beautiful iridescent appearance, and is so far decayed, that it may be scratched with the nail. The glass of some bottles of wine which had lain in a wet cellar near the Bank of London upwards of 150 years, examined by Mr. Brande, was soft, and greatly corroded upon the surface, in consequence of the partial abstraction of its alkali.

Devitrified Glass.—It has been discovered that certain kinds of glass, by exposure to a high degree of heat, lose some of the most obvious properties of glass—becoming opaque, fibrous and tough, hard enough to strike fire and to cut other glass, and capable of being cut with a file. The discovery was first made by Neumann, and afterwards investigated by Reaumur, whence this substance obtained the name of Reaumur's porcelain. This philosopher was of opinion that its qualities, particularly that of resisting sudden changes of temperature, in which point common glass is so essentially wanting, would render it of the highest utility, especially for chemical uses, where, for want of some cheap article of the kind, great inconvenience is experienced, and the practical operator is necessitated to incur the great expense of procuring vessels of platinum or other costly and perhaps still imperfectly efficacious materials.

Ornamental Trees.—The apathy which has hitherto been manifested in regard to ornamental and shade trees, is, we trust, giving way to a different spirit. The same enterprize which has so beautifully adorned our Common, and some of the streets of this and one or two other cities of New England, is spreading in various directions, and usurping that want of taste which has condemned to the axe everything in the shape of a tree that was fit to burn. One or two of the adjacent towns, we understand, are making efforts to line their streets with ornamental trees; and we wish them success.

The objection which has been made to this in the damper climate of England, that by their shade, they prevent the roads from receiving enough of the sun to keep them dry and firm, cannot, we think, have any weight here; and in the summer time, their shade is needed much more here than there. How refreshing to the wearied traveller is the shade of trees, on our hot dusty roads, almost every one has experienced, and has felt willing, no doubt, to contribute his share towards converting these deserts into groves. The elm is the tree generally chosen for this purpose; but we should prefer a variety, which might be easily had, and which, by their variety of foliage, would add much to the beauty, and at the same time neither detract from their utility nor add to their expense.

Metallic Wealth of the West.—This is every day more and more developing itself. A geological report lately made in the state of Tennessee furnishes interesting information respecting the flourishing state of the iron manufacture in that state. A scientific traveller has lately discovered almost literally a mountain of iron, yielding 70 per cent of pure metal. Large masses of pure native copper are also known to exist, at the northwest. What more interesting question can come up before the American people, than in what hands these treasures will at a future day be; and what more certain truth, than that upon education, in its widest sense, and the diffusion of useful knowledge, the decision of it depends—a decision which it is yet in our power greatly to influence.

Flax Spinning.—A Brussels paper quotes a letter from Lille, (France) as follows:—"A great establishment is now erecting in this city, intended for spinning flax by machinery. Thus the great problem is solved, for which the Emperor Napoleon offered a reward of a million of francs, and we shall now enter into competition with the English, who eagerly buy up all the flax of our country."

Use of Zinc.—The New York Mechanics' Magazine, contains an important article on this subject, by Prof. Gale, of New York University. He says that both water and other liquids dissolve their oxyde, which is poisonous and disagreeable to the taste, so that it cannot be used in the form of vessels of any kind. For roofing, it is equally objectionable. "In the first place," he observes, "the expansion of the metal is so great, by slight changes of temperature, that the junctures are exceedingly liable to get out of place from expansion and contraction, so that in the present manner of putting on the metal, the buildings are constantly liable to leak." Two objections to its use arising from its brittleness are stated. 1. "It is so brittle that two sheets cannot be put together by folding, but must be joined in a sort of double coil (the two edges of the adjacent plates rolled up within each other;) and though this joining, when new, will keep out rain tolerably well, it can never be made to resist the action of melting snow," lying on the roof. 2. This fragility, which is increased in a tenfold proportion by diminishing its temperature, renders it very unsafe; as at a freezing cold, it is almost as brittle as glass—so that any heavy body falling upon the coils which project above the roof, will cause an injury which it is exceedingly difficult to repair. In addition, the oxyde which is gradually formed is as constantly washed off and dissolved by the rains, and the rain-water collected in the cisterns is thereby poisoned, and rendered "almost entirely unfit for all domestic purposes."

The Chemistry of Nature.—The processes by which nature works, in the caverns of the earth, some of which are probably completed only in the course of centuries, must forever remain little understood. It is with labor that man imitates, often poorly, a few of her crystallizations and mineralizations. The following experiment, related in the Scientific Class Book, affords one of the few artificial illustrations, on a small scale, of what is ever going on in nature's great laboratory.

Silica is nearly insoluble in water, and probably in all acids except the hydrofluoric. * * * When silica is fused with

a large proportion of potupa, a compound is produced readily soluble in water, forming the *liquor silicum*—or liquor of flints, of old writers. Prof. Liegling of Efurot, having prepared this liquor with a large quantity of water and of alkali, suffered it to stand for eight years in a glass vessel, covered with paper, when crystals of salts of potash were formed at the bottom of the vessel, and the remaining liquid, about two ounces, was covered by a transparent crust, consisting partly of carbonate of potash, and partly of crystallized silica—the latter being so hard as to strike fire with steel.

By some magnificent operations, perhaps of a nature similar to this, the beautiful rock crystal and the precious gems are probably slowly concreted, in the interior of the earth. Thus may have been formed even the massy rocks which form the skeleton of the external globe itself.

Fossil Traces of Birds.—Much interest has of late been excited among the scientific, by the discovery of vast numbers of impressions of birds' feet in the sandstone rocks of the valley of the Connecticut. They have been lately described by Prof. Hitchcock, of Amherst, in the Journal of Science, whence these brief statements are collected. The tracks are not discoverable on surfaces which have been long exposed to the action of the weather, but only where the upper layers have been recently removed. Whole lines of tracks of the same fashion are found, leaving no room to doubt that they were made in succession by the same bird, in walking, the tracks of the left and right feet alternating, being perfectly distinguishable. The tracks of a great variety of species are observed, some of them very large. One specimen is described as two feet long, and the length of the step appears to have been about six feet. Many of the tracks appear on surfaces of considerable slope, and yet present no difference from those on level surfaces, so that it becomes apparent that they were made before the elevation of the rocks to an inclined position.

CHRISTIAN RADICALISM.—We fear Mr. Withington, the author of this book just issued by Perkins & Marvin, will not receive the credit of being so much of a philosopher as this work shows him to be. He writes as a man of the world, and not as the defender of any party, and has ventured to state many important truths which will not soon be very popular. No reasonable man, however, will fail to derive benefit from its perusal.

MORAL AND SPIRITUAL CULTURE IN EARLY EDUCATION.—We have received an address delivered before the American Institute of Instruction on this subject, by R. C. Waterston. Were only the spirit imbibed and the principles carried out, which are exhibited in this address, we might hope speedily to see better things with regard to the general state of the world. The writer insists upon the necessity of making moral and spiritual keep pace with intellectual cultivation, as the only means of making man what he ought to be.

THE YOUNG MOTHER.—This new work is a treatise on the physical management of children, by Dr. Alcott, author of the "Young Man's Guide" and Editor of the "Moral Reformer." The subject is one of great importance, and on which the community need a great amount of information. We think no family should be without this book.

LECTURES ON GEOLOGY.—Prof. Silliman's chemical course of lectures has been opportunely succeeded by one on Geology by Dr. C. T. Jackson, an able man in this department, and whose lectures have given great satisfaction. The best thanks of the community are due to such men as these, for their efforts to awaken an interest in the most important branches of science.

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NATURAL HISTORY OF WATER.

BY C. T. JACKSON, M. D.

Water essential to organized beings. Divisions of water.

There are, perhaps, few subjects more worthy of our consideration, than the Natural History and Properties of Water—a liquid which enters into the composition of an endless variety of beings belonging to the three kingdoms of nature, and which is essential to the existence of animals and plants.

It is certainly a remarkable fact, that we are prone to neglect those things which are exposed to our daily observation, while we seek eagerly after those which are rich, costly and rare.

I trust, however, although the subject which I have selected for this essay is one of the most common and abundantly diffused substances in nature, that we shall find it a fruitful topic for reflection, which may advantageously engage our minds, and that from its consideration we may derive some useful lessons, applicable to the ordinary affairs of life.

In the course of this essay, I shall notice the great divisions of water; their relation to each other, to man, animals and plants; showing the final causes of some of the most remarkable phenomena. I shall endeavor, also, to give some practical rules for estimating the purity or impurity of water, so that the reader may be enabled to detect, by means of certain tests, the nature of the foreign

matters which it often contains. Some of these foreign matters are innocent, while others have an important influence on animal life and health.

Water may be considered one of the primitive formations of geology, for it enters into the composition of even the oldest rocks; and the newer, or secondary, and tertiary rock formations, were certainly deposited in this medium—for they contain abundant remains of shell-fish and other animals of aquatic origin, while the substance and structure of these rocks bear indisputable proofs that they were deposited slowly from suspension in water, while their inferior portions bear also marks of subterranean fire.

It is evident that water performed a conspicuous part in the work of creation, and was one of the material instruments in the hand of the Creator, by which he constructed the beautiful world in which we live.

If all the rocks which are known to have been produced by igneous action—(and the whole group of unstratified rocks are of this class)—were formed suddenly, at one time, it is evident that water could only have existed in the state of vapor, or steam, forming an atmosphere around the globe. It is, however, more reasonable to suppose, that they were not all produced at the same moment, and that some parts of the earth's surface were sufficiently cool to allow water to exist upon it in a liquid state, while other rocks and mountains, fresh from the glowing furnace, would only permit it to exist over them in the state of vapor. Leaving these speculations for the consideration of geologists, let us now examine more particularly the subject which we have chosen for our reflection.

Water being inorganic matter, must be regarded as belonging to the mineral kingdom. The term mineral water has however been applied to designate certain waters holding saline matters in solution. It would be more ap-

propriate to designate them by the name, saline waters—the principal salt giving the specific name to the spring.

We shall then regard water, generally, as a mineral species, and all the saline waters as varieties of the species, the number of which is necessarily very great.

Water is a mineral existing in three different states, solid, liquid and gaseous, according to the temperature and pressure to which it is exposed. When pure, it is colorless and transparent, and has no taste or odor. At 60° F. its specific gravity is 1, or unity, and it is at this temperature, and when the barometer stands at 30 inches, taken for the standard of specific gravity for all other solid and liquid substances. Thus when a substance weighs just twice as much as its bulk of water, its specific gravity is said to be 2. When five times as heavy, it is said to be 5, &c. In order to ascertain the specific gravity of any substance, we have only to suspend it by a delicate filament of silk, or by a hair, to the bottom of a balance pan; then to determine its exact weight in the air by placing weights in the opposite side of the balance until it is counterpoised; after which we have only to fill a glass vessel with distilled water and bring its temperature to 60° F. by warming it if too cold, or cooling it if too warm. The temperature is ascertained by a small thermometer plunged into the water. We have now only to bring the water into such a situation that the substance whose specific gravity is to be ascertained may be entirely immersed in it when the balance is in equilibrium. Weights are then added to the pan over the substance, until the balance is exactly equipoised. The weights required for this purpose give exactly the weight of the water which has been displaced by the substance; consequently the weight of its bulk in water. We have then only to divide the weight of the substance in air by the weight it lost in water, to have its

exact specific gravity. If the substance is lighter than water, it must be sunken by weights; and the weight required to sink it, shows how much lighter it is than water, or its specific levity. When the specific gravity of liquids is to be ascertained, it is done by weighing them in a counterpoised bottle, which, when full of pure water, weighs 1000 grains; and the bottle being filled with the liquid in question, its relation will be at once indicated by the difference of weight. The greatest density of water is when it is at the temperature of 40° F. It expands above and below this temperature; above, until it changes its state and becomes steam at 212° F.—below, until it becomes solid or ice at 32° F.

When water freezes it expands, owing to the interstices left between its crystals, which are so arranged as to occupy more room than the particles of liquid water did before. The most beautiful crystals of water form from its vapor in the vicinity of water falls; and it has under such circumstances been observed in perfectly regular crystals, of a rhomboidal form, having angles at 60° and 120°. It also exhibits the secondary forms, derived from the rhomboid, such as the six-sided prism, and the bi-pyramidal dodecœdron.

Hail presents us sometimes with regular crystals, which are composed of two six-sided pyramids applied base to base, and generally truncated or replaced by one plane at one of the pyramidal terminations. The specific gravity of ice is 0.916 water at 60° F. being 1.000. It is then about one tenth lighter than water at the ordinary temperature. Ice is known to float on the surface of liquid water, owing to its specific levity. It is also observed that ice contains a great number of air-bubbles, which contribute partly to render it light. These bubbles consist of atmospheric air dissolved in the water, which, not being capable of congelation, is separated from it as it freezes.

Ice may be formed perfectly free from air-bubbles, by the following means. A flask is to be partly filled with water, and a stop-cock connected with its neck. Then the water is caused to boil, which separates the air from it, and by continued boiling it is driven from the vessel by the steam. While the surface above the water is full of steam, the stop-cock is closed, and then the water is perfectly free from air, and it may be frozen by placing it in a freezing mixture of snow and salt, when it will be found converted into solid ice, perfectly free from air-bubbles, and as transparent as the finest glass. It is found to be still lighter than water, and will float on its surface. In this state the ice may be moulded by the hands into a lens, which will concentrate the rays of the sun like a burning glass, and may be used for the same purpose.

Ice is a bad conductor of heat, so that it melts slowly and at the surface first. It is, when perfectly dry, capable of becoming electric by friction. It is then a non-conductor of electricity. The uses of ice and the expansive power of water in freezing, are very numerous, and are beautifully contrived to subserve useful purposes in the economy of nature. Were it not for its expansive property in freezing, it would sink to the bottom of the water, and thus would remain forever bound in chains of frost. A whole lake would, by this process, in a severe winter, become converted into an enormous mass of ice, which our summer months could never melt. The aquatic plants and animals would be destroyed. No longer would our brooks irrigate the soil; and a scene of desolation would be the necessary consequence.

The expansive force of freezing water acts also as nature's ploughshare; for as each pebble and grain of sand are surrounded by this liquid, when it congeals they are forced asunder. The process being very frequently re-

peated, in the course of the winter months, the grains of sand and stones are forced farther and farther asunder; and when spring, with its genial warmth severs their icy chains, we find the soil loose and spongy, suited admirably to favor the tender plants, which shoot up through its surface, and the delicate rootlets and spongioles of trees which seek their nourishment in the soil. Every reflecting person who walks abroad in early spring, must be struck with this beautiful provision of nature. The power of freezing water is also an efficient means of breaking down the rocks into soft and fertile soils; for when water freezes in the interstices of rocks, it tears them asunder, and causes them to crumble to dust. This expansive power is so great, that when an iron bomb-shell is filled with water, and closely stopped, and then exposed to cold, the water, in becoming solid, expands with such energy as to burst it asunder. This experiment has often been tried with success in Quebec.

I need not remind the reader of the domestic uses of ice; they are too familiar to require mention. I would remark, however, that in some warm countries, as in Sicily and Italy, it is one of the necessaries of life, and one of the most common and valuable substances for preserving their light wines in summer—while it is of great value in the promotion of health, and enables the people to withstand the burning sirocco winds.

Ice forms in enormous masses beneath the arctic circles, where it chiefly remains, forming immense mountains and overhanging cliffs, some of which become undermined by the action of the sea, and falling off into the water, are floated to distant regions in the form of icebergs, which frequently render navigation in their vicinity extremely dangerous. In the spring and early summer, the Grand Banks are covered with wandering icebergs and islands

of ice, which come from the north arctic regions, and are floated to the south by marine currents. Icebergs form conspicuous objects of admiration and dread to the mariner. Towering several hundred feet above the level of the water, their crystal sides reflect to a great distance the brilliant rays of the sun, while they sink five-sevenths of their bulk beneath the waves. As their inferior portions are melted by the warmer water, they become top-heavy and tumble over in the sea, the lower extremity then becoming the summit of the mass. Sometimes they unfortunately tumble over upon an ill-fated ship, and crush and sink her in the deep. Islands of ice, or sunken ice, is still more dreaded by navigators, because it is not readily discovered, and a ship may run against it unawares, and be instantly wrecked.

The mountain tops, when sufficiently elevated, are also regions of eternal ice and snow. The limits of perpetual frost vary according to the latitude and mean temperature of the place. In Switzerland it is about eight or nine thousand feet above the level of the sea. In Sicily, upon Mount Etna, it is at nine or ten thousand feet elevation above the Mediterranean. This mountain, which is nearly 11,000 feet high, presents the singular phenomenon of a burning mountain of ice. The traveller may stand on the burning crater of this volcano, with his feet sunken in hot cinders, while his head is exposed to a temperature below zero, F. In Switzerland the glaciers fill up the alpine valleys between the high and craggy peaks of rock, and are called, when of great extent, *mers de glace*—seas of ice. The most remarkable of these glaciers, are that of Montain Verte on the side of Mont Blanc, in Savoy, and the Glacier du Rhone, near the Mont St. Gothard. From the latter, the river Rhone takes its rise and courses onward, beginning as a mountain

torrent, and gathering its waters into a larger mass, until it forms the great river which empties itself into the Mediterranean, after having irrigated a great portion of Switzerland and the most important departments of France. The ice on the Mer de Glace at Mont Blanc, was calculated by Saussure at 800 feet in thickness; and it has deep chasms extending to the bottom, into which travellers have sometimes fallen never to return. These enormous masses of ice are formed from the snow, hail and rain that collect on the sides of the mountains. The snow being partially melted by the heat of the noon-day sun in summer, agglomerates into granular ice, of which the glaciers are all composed. Their surface is rough and hard, so as to give a good foot-hold to the traveller; while the ice presents itself in wavy and conical masses, piled up one upon the other, resembling the appearance which a tempestuous ocean would exhibit if suddenly frozen into solid ice.

The glaciers extend down into the warm and fertile valleys; and as their under surfaces are buoyed up by water, they are continually and slowly advancing into the plains. It not unfrequently happens, that they rush onward with a sudden and violent movement, and bury any village situated at their feet. The Glacier d'Argentiere, in the valley of Chamouni, threatens soon to overturn the village of Argentiere, situated at its base. Already the glacier has heaped up a mound of soft mud, which it is continually pushing forward towards the ill-fated town. Martigny and Interlachen have been flooded by the bursting of glacier lakes, and such accidents are not at all uncommon in Switzerland. The Swiss glaciers supplying the waters forming the greatest rivers of Europe, may be destined by Providence to support these important streams so useful to man.

Snow and hail are interesting examples of crystallization of water from its vapor. A flake of snow consists of implanted crystals, which cross each other at determinate angles of 60° and 120°. There are generally six rays thus disposed, crossing each other, and having other crystals implanted in their sides, like the plume on a feather. Snow is destined to the most important uses. By its lightness it falls in delicate fleecy masses, covering the surface of the earth, and by the interstices between its particles, a great quantity of air, which is a bad conductor of heat, is imprisoned, and serves to render the snow a more perfect non-conductor of heat. Thus the snow, by its lightness, is enabled to preserve the earth from severe cold, while by its color it prevents the radiation of heat into space, and reflects light to cheer our long winter nights. It is most beautifully ordained to subserve useful purposes to man and the whole animated creation.

Hail is produced by a more compact arrangement of particles of frozen water, and usually crystallizes in the form of a pyramidal dodecaedron, or two six-sided pyramids applied base to base, the summit of one pyramid being replaced by a plane. The formation of hail is not unfrequently accompanied by electric phenomena of thunder and lightning, particularly in mountainous countries. By the use of electric conductors, a means has been discovered of averting their fury; and this expedient is resorted to in France and Switzerland to protect their vineyards.

Let us now consider the great natural divisions of water, and observe how they are related to each other and to organized beings.

The largest of these great divisions is the *ocean*, which covers three fifths of the earth's surface, and appears to some persons a waste of waters, of little benefit to man-

kind. The ocean is, however, of the greatest importance to man, and is essential to the harmony of nature's laws. It serves as the great highway of nations, and bears over its bosom the products of the most distant climes. It separates countries from each other, and by its extent imposes an impassable barrier to the inroads of barbarians. The savage is unable to traverse the great deep in his frail canoe, while civilized nations, excelling in the art of naval construction, are enabled to command the empire of the sea. The gallant ship, with her batteries of thunder, managed by skilful seamen, lives on the ocean, visits the remotest climes, plants and defends thriving colonies of civilized men, and thus extends the bounds of civilization. The land that once nourished only a few savage and ferocious hunters, is now peopled by millions of enlightened freemen.

The ocean is the great store-house of the rain, from whence nature distils the genial drops that nourish vegetation, and supply animals and man with pure water. From this great basin the fresh water is evaporated, leaving the salts behind. The vapor is dissolved in the air, and is transported to distant regions like an invisible spirit on the wings of the wind. In the higher regions of the atmosphere, where the temperature is lower than at the earth's surface, the moisture of the air is condensed into clouds, which are composed of an infinity of little globules or vesicles, not more than $\frac{1}{4000}$ of an inch in diameter. They are hollow, and are filled with air, which serves to float them in the atmosphere. When by concussion or by electric changes these globules are broken, they coalesce and form drops of rain, which fall to the earth in showers, and supply water to plants and animals, while the excess passes off in the form of brooks and rivers, into the sea, from whence it was first derived;

and thus the circle is complete. When the temperature of the air is low, the water from the clouds descends in the form of snow, which covers the earth with a soft white fleece, and protects its surface from severe cold. Larger drops, combined by the agency of electricity, and congealed by cold, descend in the form of hail.

The depth of the ocean has been variously estimated. Laplace thought it must be upwards of ten miles, while others estimate its average depth at two or three miles. No soundings have ever been made beyond the depth of a mile and a half. A mean between these calculations will probably give us an approximate idea of its average depth. The highest mountains are elevated above the sea only five miles; and probably this may be considered the greatest depth of the ocean.

Sea water contains a great number and variety of saline matters, the most important of which are the muriate of soda or chloride of sodium, in solution, muriates of magnesia and lime, sulphates of soda and magnesia, hydriodates and hydrobromates of magnesia and soda, besides minute proportions of several other muriates and sulphates. As all saline matters soluble in water are carried by rivers into the sea, we should naturally expect to find them in the waters of the ocean.

The origin of the saline matters of sea water has never been satisfactorily accounted for, but they probably are derived by the washing of water through the soil, which in its former state, probably contained a much larger proportion of these matters than are now found in it.

The saltness of the sea no doubt subserves useful purposes in the economy of nature. It prevents rapid putrefaction of animal matters, which float on its surface and cover the shores. In hot climates, this conservative property is especially useful, as there the heat of the sun

would cause animal matters thrown up on the coast to putrefy with great rapidity, and taint the air with unwholesome effluvia. But we may look beyond this conservative property of sea water, and observe that the saltness of the sea serves other useful purposes. It enables other animals and plants to exist beneath its briny waves, and many peculiar forms of life are thus presented—animals adapted to their peculiar situation and modes of life, capable of enjoyment in themselves, and of subserving in a thousand ways the wants of man. The ocean is peopled with its myriads of animated creatures, which are mutually dependent on each other, and the last link in their chain of dependance reaches man himself, who styles himself the lord of the creation.

Lakes are smaller divisions of water, surrounded by land, and supplied by springs, brooks and rivers, and having generally rivers for their outlets. They are usually collections of fresh water; but when salt, they are called *caspians*, after the Caspian Lake. The Dead Sea is a caspian charged with a great quantity of saline matter—far exceeding in quantity the saltness of the sea. Its specific gravity is 1·14. It contains from 19 to 25 per cent. of saline matter, consisting of chloride of sodium, chloride of magnesium, chloride of calcium, chloride of potassium, sulphate of potash, sulphate of soda. These salts are evidently carried into the Dead Sea by the river Jordan, which in its track through the numerous volcanoes among which it winds its way, is charged with a smaller proportion of these salts. The Dead Sea having no outlet, but through the medium of evaporation, the fresh water is removed by this process, and an excess of salt remains behind. The great lakes of our country appear to have been once filled with salt water, which has been discharged by outlets into the sea,

and replaced by fresh water derived from rain, brooks and rivers. As we have not time nor room to discuss this subject more particularly, we refer the reader to Dr. Mitchell's memoir appended to Cuvier's Theory of the Earth. The great lakes of North America are the largest bodies of fresh water in the world, and are worthy the attention of philosophers.

Rivers are large streams of water, derived from brooks, springs and rivulets, which take their rise in the more elevated parts of the country, and flow down through the valleys into the sea. Their action on the rocky strata is an interesting subject for the consideration of geologists, but we cannot stop to discuss it here. The great rivers of a country are among its important resources. They serve as natural inland canals, and aid in the conveyance of articles of commercial use. They turn our great wheels in the manufactory. They supply water for the irrigation of the soil. The longest river in the world is the Mississippi and Missouri, which extend upwards of 4490 miles. The Amazon in South America is 4000 miles in length. The longest river in Europe is the Volga, which extends but 2000 miles. In Asia, the river Obe is 2550 miles long. The Nile in Africa extends to the distance of 2000 miles. North America is then most distinguished by the length of her rivers, which correspond with her geographical extent. Rivers carry off the surplus of water from the land into the sea, and thus effectually prevent inundation.

A brook or rivulet falling over a ledge of rocks forms a *cascade*. A river tumbling over a precipice forms a *cataract*. When the situation of a cascade is picturesque, it produces a most pleasing effect in the mind of the observer. A stupendous cataract falling over a mountain ledge produces the most sublime emotions, and no one can con-

template the scene without feelings of admiration and astonishment. The cataract of Trenton Falls is one of the most picturesque in this country. "Niagara," observed a friend of ours, "overpowered us with terror; but the falls of Trenton steal away the heart."

Lord Byron, speaking of the falls of the Velino or *Cascata del Marmore*, describes that cascade as

> "The hell of waters! * * * *
> Lo! where it comes like an eternity,
> As if to sweep down all things in its track,
> Charming the eye with dread—a matchless cataract,
> Horribly beautiful!" &c.

If Byron could thus have spoken of a small artificial cascade in Italy, what would he have said had he contemplated the great cataract of Niagara, where every minute more than 600,000 tons of water tumbles over a precipice to the distance of 150 feet, with a noise of terrible thunder, making the earth tremble around!

Water is one of the principal components of the juices of plants and the blood of animals, and is absolutely necessary for the existence of these fluids, which form the circulating medium through which all the nutritient matter is conveyed to these various organs, and the fluids by which worn out parts are removed by excretion. The sap or common juice of plants consists chiefly of this fluid; and the blood of mán contains ninety per cent of water. Plants as well as animals and man can bear the privation of food longer than they can that of water, which is absolutely necessary to their existence, as the vital air is to animals; and like that, there is no substitute for it.

It is also essential to the health of man that he should be supplied with pure and wholesome water, free from all deleterious salts and other foreign matter of an injurious

character. Salt water will not quench thirst nor support life.

A minute and almost insensible proportion of common salt may not render the water absolutely injurious, but larger portions of this matter combined with many other deleterious salts, may render the water altogether unfit for use; and the health of those who drink it will, if not immediately, at least in the course of time, become undermined and destroyed. Some diseases are produced by the use of impure water, which require the most dangerous of surgical operations for their cure. Deformities of an hereditary nature are thus frequently induced, which give a loathsome and disgusting form to a whole community of people. The diseases goitre and cretinism, common in the mountainous cantons of Switzerland, are generally attributed by the people and their physicians to the impurities of water that is drank by them, which water contains an infinity of fine particles of comminuted minerals, carbonate of lime, &c., abraded from the mountain sides by the glaciers which supply the rivulets and springs, from whence they obtain their water for domestic use.

It is evident that the health of a whole community may be so affected by impurities in water drank by them, as to give a peculiar morbid expression to their countenances, which causes the observant eye of a traveller to remark it, while he in vain endeavors to account for the phenomenon.

Who has not remarked the expression common in some of our cities, as in New York and Boston, which is called a "care-worn and anxious expression?" This expression, I will venture to assert, is not so much the result of "too much care," as it is of abdominal disease, produced by the habitual and continued use of impure and unwholesome water, which has fixed upon us this morbid stamp. I do not know that the people of the cities in question are sub-

ject to more care than those in other districts, but I do know that they use every day, in many forms, a variety of noxious ingredients, which they pump up from their wells, dissolved in the water, and which enters into every form of food and drink they use in their houses.

Water, in percolating through the soil, dissolves every thing soluble which it meets in its course, and the finest filter can never separate them from it. When the soil is everywhere filled with the most abominable filth, and the water is continually passing through it, and running as it infallibly must into our springs and wells, it is evident that the sources of impurity are sufficiently abundant to account for the presence of such as I shall presently demonstrate exist abundantly in the well water of this city. The soils through which water percolates modify in a remarkable manner its composition. Springs are but collections of water which, derived from rain, filters through the neighboring hills, and rises to the surface by hydrostatic pressure. When a hill is cut down, *e. g.* the hill on the late Gardiner Greene's estate, many people are surprised to find that the springs disappear, and there is now dry land where formerly existed the bottoms of never-failing wells. If the doctrine of physics which explains the origin of springs was generally understood, the question would not be so often asked—" What has become of the water?"

The diluvial sand and gravel of that hill was the source from whence the water was derived, and the clay beds at its base served to prevent it from sinking farther. Now the sand, like a sponge, absorbed the rain as it fell, and allowed it slowly to filter through to the clay at the bottom, where it remained, forming a permanent supply. This hill being removed, no more water is found there.

Water, in draining through a soil, is charged with mineral, vegetable and animal matters. If a soil is charged

with soluble salts, these will be found abundantly in the water of the wells. If the soil contains carbonate of lime, that salt will be found in solution in the water, combined with an excess of carbonic acid. If pyrites of iron occur in the soil, then sulphate of iron will be found in the springs; and if carbonate or any other salt of lime also occurs, we shall have also sulphate of lime dissolved. Vegetable matter is generally found in the water in the state of an extract, consisting of ulmine or geine. Animal matters are found in a putrescent state, with many animal acids and ammoniacal salts. It is notorious that the dreadful scourge called the Asiatic cholera, a disease which has travelled over the world, selected for its favorite abodes those cities which were founded on the tertiary limestone, where the water is known to be charged with an abundance of carbonate of lime—a salt that is known to derange the functions of the alimentary canal when it is drank. Most strangers who visit the Western States have experienced inconveniences arising from this cause. The water of Paris and of Vienna is also known to be charged with the same impurities, and produces the same effects.

Now the countries I have mentioned are the very places where the cholera produced the greatest havoc, and where it remained for the longest time. Cholera is considered an epidemic disease; and those causes which I have mentioned were peculiarly calculated to act as predisposing and exciting causes of the disease.

When an epidemic disease prevails, we should endeavor to ascertain and avoid the remote causes which may induce it, and thus diminish the danger to which we are exposed. A knowledge of the geology of a country, and the nature and distribution of water, may often serve as guides. Every physician certainly ought to be acquainted

with this subject, for he may otherwise send his patient into the midst of danger, when he intends to remove him far from it.

In order to detect the impurities existing in water, the following tests may be used, which will give an approximate idea of the relative impurity of the water in question. If the substances are to be separated from each other and quantitatively estimated, it can only be done by an experienced chemist. The tests indicating the nature of the foreign matters and the estimation of their gross amount, are, however, easily applied.

In order to form an estimate of the quantity of foreign matter in the water, its specific gravity may be taken as before described. Then, according to Kirwan, "subtract from this number the specific gravity of pure water, and multiply the remainder by 1.4. The product is equal to the saline conten s in a quantity of the water, denoted by the number employed to indicate the specific gravity of distilled water."

To ascertain the correctness of this operation, evaporate 10,000 grains of the water to dryness, and weigh the residue.

The test for muriates, or chlorides in solution, is a solution of nitrate of silver in distilled water. If any muriate or chloride is present, a white precipitate will be formed by this test, consisting of chloride of silver.

If no immediate precipitate takes place, expose the solution to the action of sunlight. If it becomes bright red, and a bistre brown precipitate takes place, ulmine is present. If it turns black, animal matter is present.

To detect the presence of any free acid, use a slip of blue litmus paper, which will be turned red if any free acid is present. Boil the water, and if, after boiling, it ceases to redden litmus paper, the acid was the carbonic

acid. If it still reddens the blue paper, the acid is of a fixed nature, and is to be examined by the tests for sulphuric, muriatic and nitric acids.

To detect sulphuric acid or any sulphate, use a solution of muriate, or acetate of barytes; if these substances are present, a white precipitate will form. Muriatic acid will be indicated by the test of solution of nitrate of silver. Nitric acid may be discovered by evaporing the water to small bulk, then adding a particle of gold leaf and a drop of muriatic acid; the gold will be dissolved if nitric acid is present. If nitrates exist in the water, they will be discovered by evaporating the water to dryness and throwing the solid mass obtained on burning charcoal. If deflagration take place, it indicates the presence of nitrates.

In order to discover if lime exist in the water, test a portion of it by means of oxalate of ammonia. A white precipitate indicates lime.

To discover iron, drop into the water a little of the solution of ferrocyanate of potash. If iron is present, a blue precipitate will form. A decoction of nutgalls may be used in its stead, and then a black precipitate will ensue.

Salts of soda may be detected by evaporating some of the water to dryness, and heating some of it in a piece of platina foil in the flame of the blow-pipe. If it color the flame yellow, soda is present. Salts of potash are detected by evaporating a portion of the water to small bulk, and then dropping into it muriate of platina. A yellow precipitate indicates potash.

In order to decide the question whether the water is "hard" or "soft," we have only to make a solution of castile soap in alcohol, turning off the clear portion for use, then to add some of this tincture of soap to the water. If no turbidness ensue, and no flocculent precipitate take

place, the water is soft and fit for washing; but if the water gives a copious flocculent precipitate, it is hard and not suitable for this purpose.

By means of these tests all the usual questions respecting the purity or impurity of water may be solved, in a manner sufficiently accurate for ordinary purposes.

Mineral springs, or saline waters, would constitute an interesting subject for discussion, but we have not at present either time or room for their full consideration, and shall therefore take a hasty view of them.

Mineral waters are sufficiently abundant in our country, and are found to be extremely valuable in the cure of certain derangements of the digestive organs, and in scrofulous diseases of the system. The most remarkable springs of this character contain sensible proportions of iodine and bromine, in the state of hydriodates and hydrobromates of soda and magnesia, to which substances perhaps they owe chiefly their anti-scrofulous action, while the free carbonic acid, and the carbonates of soda and magnesia, give them a mild and salutary action on the digestive organs. Mineral waters will not, however, serve for ordinary use as drink, but are to be considered as medicines; and their use should be regulated by the advice of skilful physicians; otherwise they are liable to do injury, as not unfrequently happens, where they are drank injudiciously, and in great quantity. This must evidently be the case, if the waters possess any marked action on the system.

Chalybeate waters are those which are charged with carbonate and sulphate of iron. They are powerfully tonic, and are, under favorable circumstances, and where there is no inflammation of the mucous membrane of the stomach, of great use in the cure of dyspepsia, and other derangements of the system arising from debility.

Sulphur springs are generally charged with sulphuretted hydrogen gas and carbonic acid, and contain hydrosulphates of soda, potash, lime, &c., besides carbonates of the same bases, and carbonate and sulphate of iron. Although they have a very unpleasant odor, (like that of rotten eggs,) persons who have become habituated to them like their flavor, and become strongly attached to their use. Such waters are highly active on the system, and are efficient when used externally and internally, in the cure of chronic rheumatism, some cutaneous diseases, and certain scrofulous tumors. Their use, like that of all other mineral waters, should be regulated by the advice of physicians, who should be well acquainted with the composition of the waters in question, and their action on the system.

Salines, or salt springs, are sources of water charged with large quantities of chloride of sodium in solution. They are found abundantly in the western parts of our country, as in New York, Ohio, Pennsylvania, and along the whole range of the Allegany mountains, in various places. They are especially valuable in the western country, as sources from whence an abundance of salt may be obtained. They are frequently found in the immediate vicinity of coal mines, which supply fuel for the evaporation of the water, by which means the salt is obtained.

The full consideration of this subject should form a separate essay. What I have now presented may serve as an outline of a more elaborate report on some future occasion.

Pure water is a fluid of such great importance to mankind, that I deem it expedient to devote the few remaining pages of this Tract to its consideration. It is very difficult to obtain water absolutely pure; but nature presents it to us

in some states closely approximating that condition. The chemist, for delicate operations, requires water absolutely pure—exempt from the slightest trace of foreign matter. The method by which he obtains it is by distillation. For this purpose he selects water exempt from carbonic acid gas; or if it contains this gas, he saturates it by lime water, or boils it for a few minutes, exposed to the air, to drive the gas off. Then the water is placed in a clean glass retort, and a globular receiver is attached to its neck, and covered with cloths wet with water. The water in the retort is then slowly and carefully boiled, so as not to carry over any spray. The steam passes through the neck of the retort, and into the receiver, where it is condensed into water. The evaporation should not be carried on too far, lest any organic matter which it might contain should be decomposed, and its gaseous products should pass over with the steam into the globe.

In this state, the distilled water is absolutely pure, and is suitable for chemical operations. It consists, according to Berzelius, of 88.904 parts by weight of oxygen, and 11.096 of hydrogen; or, by measure, of one volume of oxygen, and two volumes of hydrogen gas; and the compound is considered to be formed of one atom or equivalent of each element. These results have been obtained by the careful and elaborate researches of the most distinguished chemists of Europe, who have not only analyzed or separated water into its elements, but have combined these elements again in the same proportions, and reproduced water, so that the synthesis confirmed the analysis.

The chemical properties of water form an interesting subject, to which we might devote many pages; but we have no room for the discussion.

Water is presented by nature in its purest form as it falls from the clouds in the state of rain; but even in this state it contains a considerable proportion of gaseous matter in solution, such as oxygen gas and carbonic acid, derived from the atmosphere. During thunder storms, it not unfrequently contains a minute quantity of nitric acid, which is produced by the passage of lightning or electricity through the air—the oxygen and nitrogen combining at the points affected by the electrical current.

In the vicinity of large cities, the rain water is also contaminated by the presence of fuliginous matter, or smoke from chimneys, which renders it unpalatable. Rain water which falls in the open fields is sufficiently pure for every ordinary purpose, and the oxygen gas and carbonic acid which it contains render it more suitable for vegetation and for drink than distilled water, which is insipid.

Lakes are the largest collections of nearly pure fresh water that are presented us by nature, and appear to have been destined for the supply of man. Rivers are sometimes pure, but they are liable to become muddy and foul from the action of freshets, which stir up the bottom, and wash into the stream the neighboring loam, and the impurities of the surrounding land.

When lakes are found with a clear water, and a sandy or rocky bottom, we should generally choose to obtain our supplies from them, rather than trust to more precarious sources. In England, where they formerly trusted to rivers, they now form artificial lakes or ponds, in order to allow the impurities to subside from the water.

The ancient Romans constructed stately aqueducts of solid masonry, extending for the distance of fifteen or twenty-five miles, in order to bring lake water to the Imperial City. Why they took so much pains to raise

these massive constructions, instead of laying pipes beneath the soil, does not fully appear. It is evident, however, from other remains of water works at their baths and elsewhere, that they were not ignorant of hydrostatic pressure, (as has been erroneously supposed,) but that they knew very well that a fountain would throw water nearly as high as its source. Perhaps the scarcity of metallic pipes proper for aqueducts, was the reason which urged them to construct these enormous arches across the plains and valleys, for the purpose of supplying their cities.

Artesian wells, so called from a province in France where these wells were first extensively used, have also been proposed for the supply of pure water to our cities. In some places they are of great value: as in those countries where the strata are of a basin shape, resting on chalk and plastic clay. In such places fountains are readily formed which throw up a jet of water into the air the moment the strata have been perforated and a spring of water discovered. In other places it is frequently advisable to bore for water, where it does not rise to the surface without the aid of a pump.

The greater the depth from whence the water is obtained, the more free is it from animal and vegetable matters; and very frequently springs are discovered which originate inland and break out in the soil at a distance. A knowledge of geology is absolutely necessary to those who would discover water by this process; and even with this knowledge, it must necessarily be a precarious mode of research in some places. We have seen several examples in this city where, in places not very remote from each other, very different results were obtained. We cannot, therefore, trust to the Artesian wells for a general supply of water, although this method may be applied in

some places with success. There appears but one certain and never failing source, from whence we may draw this important fluid, namely, from the lakes which are so plentifully bestowed around our city, and appear to offer us the overflowing cup of health, comfort, cleanliness and safety.

Many persons are satisfied with the present supply of water, and say that their wells are pure enough. For an answer to this assertion, look at the report of Mr. Leicester, contained in Col. Baldwin's excellent report. There it is stated that *of 2700 wells in the city of Boston, but 7 furnish water sufficiently pure for washing!* This is not merely Mr. Leicester's opinion; *it is the vote of the citizens themselves, who answered his inquiries.*

The physicians of Boston have unanimously declared, in their petition to the city authorities, that, in their opinion, a supply of pure water was urgently called for by the wants of our citizens, and that many diseases were totally unmanageable, while their patients were obliged to drink the impure well water of the city. Many of our most eminent physicians believe that the common disorder of the digestive organs called dyspepsia, arises chiefly from the use of impure water.

I have made several analyses of Boston well water, in order to ascertain whether this opinion is founded on sufficient evidence.* Some specimens have given as much as three per cent. of foreign matter, consisting of putrescent animal and vegetable substances, and saline matters, such as muriate of lime, common salt, &c.

* It would be useful to have analyses of the best and worst water of each of the twelve wards of the city; since they would settle the question, and would serve for future reference.

The following results were obtained in the analysis of some of the best well waters of this city and its environs:

A well in Hanover Street yields, in 5000 grains of water, 7 grains of foreign matter, consisting of the muriate of lime, chloride of sodium, carbonate of lime, carbonate of iron, dissolved by an excess of carbonic acid, sulphate of lime, and animal and vegetable matter.

A public well in Friend Street, which is much frequented, yields, in 5000 grains of water, 6 grains of similar salts, and carbonic acid gas.

A well in Bowdoin Street yields, in 5000 grains, 3.6 grains of similar salts, and a small quantity of organic matter.

The analysis of water from a well near Fanueil Hall Market resulted as follows:—5000 grains of this water, evaporated to dryness in a glass vessel, left twelve grains of dry, solid matter, which, being analyzed, gave sulphate of lime, carbonate of lime, muriate of lime, chloride of sodium, carbonate of iron, animal and vegetable matter. The water is considered good, and the pump is in continual operation, supplying water for the neighboring stores, dwelling houses, and ships in the harbor. It is "hard," and will not wash.

The water of a well in East Boston gave, in 5000 grains, 13 grains of saline matter, consisting chiefly of common salt (chloride of sodium,) and muriate and sulphate of lime.

Water from a well in East Cambridge gave, in 5000 grains, 9 grains of similar salts.

The water of the wells in Charlestown Navy Yard is also charged with salts of a similar character; and it is said that our experienced officers decline using it on their long cruises, in our ships of war, on account of the

prejudicial effects it exerts on the health of the men; and they are obliged to fill their tanks with purer water from the Middlesex Canal, or to obtain supplies from some other port.

How disgusting an effect would be produced, should we place before the eyes of the reader examples of the most filthy water used in Boston, I cannot say. One specimen which I analyzed, and which gave 3 per cent. of animal and vegetable putrescent matter, evidently owed these impurities to the public sewers and drains; and strange as it may appear, it was at one time sought after as a mineral water, and was publicly sold in Hawkins Street, about sixteen years ago. It was then believed that water having such a remarkably fœtid odor, and nauseous taste, could not be any other than a sulphur spring; and consequently, it was thought to be medicinal. How many cures were effected by its virtues is not related, but its medicinal powers vanished with the discovery that the spring arose from a neighboring drain, and that the odor was no other than that arising from the putrefaction of vegetable and animal matters.

The well water of Boston and its vicinity is frequently charged with carbonic acid gas in solution; and in such cases, where lead suction pipes are used to draw the water from the wells to the pumps, the lead is found to be rapidly corroded, and carbonate of lead is formed, a portion of which is dissolved by the carbonic acid and water. I have seen several instances where this effect has been produced, and the pipes were destroyed in the course of two or three years, having numerous perforations through them, while the interior portion of the pipe was encrusted with carbonate of lead and carbonate of lime—the latter having been deposited by the water, as it lost its carbonic acid gas.

Most people know that carbonate of lead is a dangerous poison, and one which is very peculiar in its action, accumulating in the system until it produces one of the most painful and dangerous of diseases—the painter's colic—followed, not unfrequently, by paralysis of the muscles of the body. How many of the anomalous symptoms observed by physicians may be attributed to such an origin, I am unable to say; but if their attention should be called to this subject, I have no doubt that water poisoned by lead will not unfrequently be found a cause of disease, in cases where it is not at present suspected. In one instance, I know that many, if not all the members of a family suffered from this cause; and the mystery was unravelled by a chemical examination of the well water and the state of the suction pipe, which was found to be perforated with innumerable holes, while its interior was coated with the carbonate of lead produced. Whenever the water of a well is found to contain carbonic acid gas, pipes of pure block tin may be substituted for those of lead.

The water of Boston is continually deteriorating in purity, and the time will soon arrive when it will become intolerable, owing to the increased sources of filth produced by new buildings, drains, vaults, &c. which furnish an abundance of foul matter to the springs and wells. I hope that measures will be speedily taken to bring pure water into this city, so as to supply the wants of every family, while the excess may be used for ornamental fountains, which will cool the burning breath of midsummer, and furnish a ready and abundant source from whence our engines may draw water to quench the ravages of fire. The amount of capital which may thus be saved is incalculable, while the proposed measure will furnish health and comfort to thousands, and be a most efficient method of securing to our city the blessings of temperance.

SEMI-MONTHLY RECORD.

TRANSMISSION OF ONE METAL THROUGH ANOTHER.—Says Mr. Dresden, in the Journal of Science, it was from an analysis of a silver denarius (Roman coin) of the Emperor Trajan, that I first found that *endosmosis* of one solid could take place, in lapse of time, through another. This denarius was brought from Malta; and had thrown off nearly all its alloy, in the form of purple and green Neapolitan patina. The proportion of copper in the coin was originally as one to nine. This patina was as hard or harder than the metal itself. In the course of ages, the copper had removed from the most internal parts of the coin, and become crystallized on its surface, showing that a slow movement may take place in the substance of the densest textures. The whole amount of copper left in this coin did not exceed one part in seventeen.

NATURAL HISTORY OF THE VALLISNERIA.—When the sexual system was first promulgated by Linnæus, many objections were urged against it, and many different arguments were advanced to prove its fallacy. Among other specious reasons then adduced against the doctrine, was the natural history of the *Vallisneria Spiralis.* This plant grows in the mud at the bottoms of rivers in Italy, (and also in the United States,) and produces male and female flowers separate from each other, and yet ripens its fruit in due season. The plant being generally submerged, the opposers of the sexual system conceived it to be utterly impossible that, in such a dense medium as water, any transference of the pollen could take place, without destruction to its flowers. But how triumphantly was this argument overthrown, when the real history of the plant was known! The male flowers were found seated on short articulated foot-stalks, and the females fixed to long spiral ones, by

which the flower was elevated to the surface at the proper season, whatever the depth of the water might be. It was discovered that the male flowers, when nearly perfect, became detached from their stalks, rose up, and floated on the surface of the stream. About the same time, the female flowers raised themselves by uncoiling their spiral peduncles, and gained the surface also. There they became fully expanded by the light and heat of the sun; and caught the pollen from the male flowers floating beside or against them, after which they closed and sunk again to the bottom, to mature the seed.—PARTINGTON'S INTRODUCTION TO BOTANY.

CUT GLASS.—This manufacture has much increased and improved in this country, within a few years. The most extensive establishment is at Sandwich, in this state. A large portion of the glass manufactured here, finds a ready sale in foreign countries. The demand for cut glass door knobs is yearly increasing. It is stated that the making of packages alone, at this establishment, employs many hands, and that six thousand large casks are required yearly. Two packets are constantly plying between the factory and Boston, transporting glass ware; and four or five vessels find constant employ in bringing Richmond coal to the works.

COLORED MAPS FOR CHILDREN.—Instead of coloring maps for the use of young children, with the sole view of making conspicuous the artificial boundaries of states and empires, why should they not be so marked as to give a picturesque idea of the natural features of the earth? Let the waters be represented by a tinge of blue; the land, green; forests, perhaps, by darker shades of green; deserts and sandy places, reddish brown, &c. The tops of mountains which are covered by perennial snow, as well as the northern seas and lands perpetually clothed with ice, might be left white. The same marking might be adopted on a globe, for the use of children. And on such maps there need be no lines or markings, but those which serve to depict some natural feature of the globe; not even meridian lines or parallels, save those which define

the five zones, which, for a few reasons, it might be well to preserve. The teacher, after having explained the topography, might proceed, in the child's presence, to mark out on the map with his pencil, the situations of such places, and the outlines of such countries, as he is already made familiar with by name and description—especially his native country. Thus it would be more vividly comprehended by him, it seems to us, how much of what constitutes a complete map is real and natural, and how much arbitrary; and he would not be led to mistake the one for the other in any case. As a still farther advance, maps not only of topography, but of geological outlines, might be introduced; either still preparatory to, or in connection with, the exhibition of the artificial divisions of the globe, in all their minuteness.

Cotton Manufacture among the Mexicans.—The cotton manufacture was found existing in considerable perfection among the Mexicans, on the discovery of this continent. Cotton formed the principal article of clothing among the Mexicans, as they had neither wool, hemp, nor silk; nor did they use the flax which they possessed for the purposes of clothing. The Abbe Clavigero informs us that the Mexicans made large webs of cotton, as delicate and fine as those of Holland, which were with much reason highly esteemed in Europe. They wove their cloth in different figures and colors, representing different animals and flowers of feathers interwoven in cotton; and they made mantles, bed curtains, carpets and other things, not less great than beautiful. They also interwove with cotton the finest hair of the belly of rabbits and hares, after having spun it into thread; and of this they made the most beautiful cloths. Among the presents sent by Cortez, the conqueror of Mexico, to Charles V., were "cotton mantles, some all white, others mixed with white and black, or red, green, yellow and blue; waistcoats, handkerchiefs, counterpanes, tapestries and carpets of cotton," and the colors were extremely fine, as the Mexicans had both indigo and cochineal. They also used cotton in making a species of paper.—Baine.

What a Man can do.—No man can tell how much he can do, till he tries to see what can be done by system and arrangement. It was said of a man who was distinguished with an almost unparalleled number of civil trusts, through an eventful period of our country's history, that while he was clerk to the House of Representatives of one of the thirteen original states, he actually wrote off the whole of the Bible, to occupy his leisure hours, besides attending promptly and regularly to his official duties. It was a good remark of a wealthy and sagacious merchant, on being met by a friend, who knew that he had a great number of vessels in port, requiring his personal attention, in addition to his other multifarious business, and who accosted him—"Why, sir, I should think you would be in a *hurry*,-you have such an immense amount of business to do"—"That," said the merchant, "is the very reason I am not in a hurry. I have far too much to do, to be in a hurry with it."—Boston Courier.

Flint in Vegetables.—Flint, or silex, exists in considerable quantity, in the stems of the grasses, and kindred plants. To this, probably, the extreme hardness of some of them is owing. The fact has been demonstrated by the actual production of glass, from the combustion of hay or straw—glass being mainly composed of silex; the other materials usually added being for the purpose of varying its quality, or rendering it fusible, an effect which the alkali naturally existing in the straw would produce, in the above mentioned experiment.

Mechanics' Institutions.—We expect before long, to furnish a Tract on the history of these Institutions. Mr. Claxton, a well known scientific mechanic, being about to revisit England, his native country, for the purpose, in part, of making observations in relation to improvements in the Mechanic Arts, and the state of Mechanics' Institutions, will probably be able to supply us with valuable information concerning those which exist or have existed in that country.

PLEASURES OF SCIENCE.

BY W. M. ROGERS.

Classification of science.	The blessings it bestows.

TRUTH is that view of things which God himself takes. Science is truth reduced to a system. In its limited signification, excluding theology, it may be divided into Mathematics, treating of numbers, relations and quantities —Metaphysics, and Ethics, treating of the intellectual and moral man—and Natural Philosophy, which relates to the properties of the objects of sense. These again are severally subdivided. In each and all of its branches, science has yielded rich blessings to man. You have only to look about you, and note the familiar things essential to our comfort and prosperity, to be satisfied that we owe much, very much to the intelligence of past generations of men—a debt which is best paid by adding something ourselves to the stock of human knowledge, and transmitting it through those who shall succeed us, with the accumulations of century after century, on to the last of our race. It is to the past and present developments of science that we are to refer the prosperity, with the promise of an indefinite increase, which meets us, look where we may. Go and stand upon the high places of our city, and while the hum of industry comes up to you, ceaseless as the murmur of the hive, observe the crowded dwellings of men stretching away in fair proportions to the distance; note the swelling sails of commerce, and the fire-sped

cars, bearing to and fro the riches of milder climes and the fertility of our own soil. Now what power was it which tore the granite from its bed, where it has rested since chaos, and piled it up a well ordered habitation for man? What knowledge guides that bark on its trackless, shoreless way amid the waste of waters? What hand has penetrated the mountains, dragged the rugged ore from its concealment, fused it into shapes to suit its purposes, and laid it down as a pathway for man, while it compels fire and water to bear him on it with a speed which outstrips the flight of the bird. These are the triumphs of science. She makes nature tributary to man. She has thrown her spell over the world for his benefit. She has muttered the charm upon the rivers of the land, and forced them to work at the wheel like a bondman, and to speed the revolutions of the lathe and the spindle. She has vexed the bosom of the earth, and forced the unwilling soil to render up her treasures, to fill his granaries, to furnish his table, and to fill his heart with gladness. Science does not stint man to the blessings of his own skies; she levels the forest, and fashions it to her mind, until the oak floats a gallant ship upon the waters, as on its element; she clothes it with wings, and sends it across the ocean, compelling the very stars to tell the mariner his way withersoever he would go, that she may pour into the lap of man the blessings of climes of which nature has been chary to his own. Thus she binds the families of the earth together in the interests of commerce, enriching each with the good of all. These are the triumphs of science. Wonderful and beneficent as they are, they constitute but part of a series succeeding many, in their day, as wondrous, and preceding others, which the imagination of man may not now compass. The spade, the screw, the plough, and all the common

implements of industry, marked each in their day as decisive an improvement in the condition of the human race, as do the steamboat and the locomotive in our own. The common implements of industry are so familiar to us, that we do not readily conceive there ever was a time when they did not exist. But the very simplest of them marks in its invention the progress of mind, stimulated by the necessities of its position to seek devices for the better supply of its wants.

The Caffres, a barbarous tribe of Southern Africa, devote themselves to war and the chase, as pursuits worthy of man, while the ignoble occupation of cultivating the soil is confined, and with the rudest implements, to their wives and daughters. An English missionary stationed among them, introduced the plough. After training the unused oxen of the country to the yoke, the Caffre chiefs assembled by appointment to witness its powers. As furrow after furrow was successively turned up, they followed in mute wonder; and at the close of the exhibition, one of them expressed his estimate of the value of the implement, by saying, "that plough is worth ten wives." We leave it to the cynical and the solitary to vindicate the Caffre's opinion of the plough. But the illustration shows us, by a glance at the misery and destitution of savage life, that the plough and other implements of industry so common to us, that we suppose any one might have invented them, are themselves improvements on ruder implements.

Thus science has brought us, step by step, invention after invention, to the present state of civilized man. Nor will she close her labors here. Her course is onward; and doubtless, in the progress of society, the locomotive and the steamboat shall come to be things of such familiar use, that they shall be estimated as we now regard the

plough—things so easy in the invention as to occur to the mind of any man. We do not know what advantages, in the progress of the race, science has in store for us; but we do know that her resources are inexhaustible. She comes to man as a bride, with the treasures of the earth, the sea and the sky, for her dower. But it is not in her dower, rich and divine though it be, that her chief excellence consists. She is to be loved and prized for herself, as well as the blessings she brings with her; and they usually woo her most successfully, who seek her with no mercenary aims.

As the advantages of science to man would open too wide and too difficult a field for us to tread at the present time, let us confine ourselves to a narrower subject—the pleasures of that scientific knowledge, which is generally accessible to the readers of the Tracts. It will not harm us, in communion with nature from a love of nature, to breathe a fresher atmosphere, than the men who measure everything by its tendency to promote the wealth of individuals and the nation. The susceptibility of pleasure from science is wealth, which cannot, to be sure, be coined into eagles, but which ingots could not buy. It gives a healthier action to the mind, to turn from the selfish views of a narrow utility, and to share with the scholar his generous pleasure in communing with nature, developing her mysteries, watching her operations, and deriving from them all, lessons of conténtment, reverence and gratitude. There is reward enough for every sacrifice, and all the toil of such pursuits, in the vigor of a mind tasked in a work it loves, in the wonders it discovers, and the noble thoughts it calls up in its investigations.

Action is a law of our nature. You have only to enclose man in the walls of a dungeon, shut up from intercourse with his kind and nature, and his mind, with nothing to

occupy it, will act upon itself, and in six months will be reduced to madness or idiocy. We must be busy, or be wretched. Now science furnishes us with agreeable occupation for our thoughts, the gratification of a rational curiosity, at the same time that it elevates and purifies.

Science furnishes an agreeable occupation to the mind. The man of business, with no relish for other knowledge than that necessary to the successful prosecution of his schemes, looks beyond the bustle and anxiety of his present mode of life, to retirement and quiet. He imagines a paradise, and thinks that in it he shall be happy. He pictures to himself a snug cottage at a just distance from the city, where he can surround himself with all that is lovely and desirable in country life. Providence favors his wishes, and he retires from business, amply rich for any rational gratification. And is he happy? Generally not. The stillness of a country life disgusts him; and he discovers, that it is not wealth, but the pursuit of it—not the game, but the chase—which is necessary to his happiness. He has formed no tastes, the gratification of which shall supply food to his mind, and occupation for his time. He is alone—a solitary being—surrounded by nature, and the wonders of nature; but having eyes, he sees not, having ears, he hears not, and perceiving, he does not understand. As a refuge from the disgust of a mind resting in idleness, he will perhaps be driven back again to the labors of the counting room and the shop.

He who cultivates an acquaintance with the world in which he lives, can never be alone. What is solitude, but the emptiness of an ignorant mind? He who can converse with nature, and ponder on the varied mysteries she brings to his notice, and with which she fills his heart with gratitude and delight, can never be alone. He needs no companionship. Let him wander forth by hill, and

brook, and grove, no rhyming, love-sick, dreaming enthusiast, but a shrewd observer of facts, a searcher after principles and laws, and nature has enough to occupy, to interest and improve, in her most common forms, without sending him to libraries for knowledge. Where the vulgar eye can see only a shapeless mass of rock, revealing nothing to the careless and unknowing, he will detect a chronicle of the past, and tracing it to its native quarry, gather something from it of the stupendous changes which have transpired in our globe. While others pass by the insect, unheeded in its toil, he will stoop to watch its labors, discover its habits, and admire the divine wisdom, which has fitted it to its sphere. The very clod, which is trod unnoticed by the common foot, in the organization of the humble herb upon it, the root, the stem, the circulation of its juices, and the provision for continuing its kind, are as a page in God's book, where he has stereotyped his power, his wisdom and his goodness. He cannot be a solitary being. The universe is open before him, and he sees everywhere the majesty and loveliness of a higher nature. Where others can perceive nothing, learn nothing, order, and beauty, and law, are revealed to him. Where others can see but a stone, he sees a God, and worships. He cannot be alone; for step by step he learns to understand what a God only could create.

Science yields a gratification to the natural curiosity. Man begins to be a philosopher with the first years of existence. The infant early seeks a knowledge of the things about it, and of the world in which it is to live. Its little hands are busy, experimenting with everything within its reach. It is well known that a blind man, on restoration to sight, cannot at first distinguish between a solid and a plane, a circle and a square. Hence the child

is continually occupied in correcting the judgment of the eye with the fingers; and not satisfied with this knowledge, it carries everything directly to its mouth, to teach it something more of its properties. The knowledge thus acquired, though humble, is of more importance than the highest branches of science—because essential to its existence, while its pleasure in the gratification of its curiosity, feeble though it be, is the same in kind with that of the philosopher, who investigates the more hidden properties of things. When Galileo turned his telescope, (which was nothing but an old organ pipe, with a plane convex and concave lens at the ends,) to the heavens above him, he was but a child of an elder growth; and as discovery followed on discovery, the liveliness of his feelings, which broke down the gravity of the philosopher, was but the "child surviving in the man." The learned world were divided on the question, whether the earth moved round the sun, or the sun and stars round the earth. The Bible was quoted to prove that the earth stood still; and the Holy Inquisition passed sentence upon Galileo for teaching the damnable doctrine that the earth revolved on its axis, and round the sun. But the telescope triumphed over the ignorance of ages. With what delight must he have perceived the verification of his theory in the crescent of Venus, and in the satellites of Jupiter, appearing and disappearing under the eye in their revolutions, with the utmost regularity. Who would not exult in the thoughts of his heart, thus lifted above his age, and borne nearer to heaven—for knowledge, when the heart is right, is an approach to God. Man pants for knowledge. His inquisitive spirit would reach all heights, penetrate all depths, and compass the limits of our nature; and whether successful or not, he comes back from his pursuit invigorated and ennobled. We may discern such

a spirit in all classes of the community. None can look on a piece of mechanism without a wish to know its principles—to trace its operation, and witness its results. The very child must spoil its rattle to find what makes a noise within.

It was observed before a committee of the British Parliament, that the railroads were behind the age, for the common road was found to answer the same purpose, at a less expense, and under some circumstances, possessed advantages not realized on the iron track. It was actually asserted that the locomotive would ascend a steeper elevation on the road than on the rail. There is a pleasure in clearing up such a fact. How can it be true?—and yet it is true. But how consistent with our previous knowledge! The car certainly moves with greater ease on the iron rail than on the common road; and we immediately infer that what is true of the level would be equally true of an inclined plane. But experience, that corrector of bad logic, sets us right here; for it is actually found, that the car will ascend a hill of a given elevation, when it will be stationary on an inclined railroad of the same elevation. We shall attempt to state the reason familiarly. The movement produced by the action of steam on the machinery of the locomotive, is not one of progression, but simply of revolution. The wheels are merely turned round without any tendency to go forward. It is the motion produced by turning the crank of a grindstone. If you place the grindstone on the ground, and turn the crank, it moves onward. The same is true of the wheels of the locomotive. Why? It is owing to friction. Smooth as the railroad and the wheels of the locomotive may seem to the eye, there are inequalities in both, and these fit into each other like tooth and pinion work, and the car must move forward.

If the wheel were perfectly smooth, and the rail too, it would turn round on the rail, without advancing. It is clear that some friction is necessary to the forward motion of the locomotive, for during the winter, when the track was coated with ice, the wheels revolved without progression. Now on an inclined railroad, there is some friction, but not enough to produce an onward movement, in opposition to its tendency to roll down; while on the common road, at the same elevation, there is more friction, and the car goes forward. Science is full of such facts,—tasking the mind in their explication, and delighting it with its own efforts, as well as with the knowledge it imparts. She has truths curious and wonderful—adapted to every class of mind. To the lofty and aspiring, she opens the wondrous harmony of the worlds above us; to the contemplative, the sweet walks of animated nature; and to the inventive, her own secrets in the structure of things. But whether we go with her where she walks in majesty among worlds, or where she developes an insect's nature, she everywhere displays wonders unsurpassed in fiction, and the more curious because true. Let us take a single instance of the unexpected and curious facts which meet us, even in the humble branches of science.

Beyond the moral of its industry, few imagine that there is anything worthy of observation in the habits of the ant. Men generally suppose that war, as a system, is confined to the human race. Yet it comes to us from competent witnesses of the facts, that various species of the ants have their wars—offensive and defensive—and with a method that would not shame the better wisdom of man. Some ant hill, where the lust of conquest inspires to high deeds, has discovered a dangerous neighbor or an easy prey at the distance of a few rods, and sends out its thousands to the strife. They are preceded by the advance guard, who

reconnoitre the enemy, and keep up a constant intercourse by orderlies and aids with the main body, and these with the parent hive. But they do not approach unobserved. The threatened city is quick with moving life, and its chivalry advance to meet the enemy, and fight *for home and country*. The combatants are ranged in opposite lines, with an interval between. Before the general onset, sometimes an ant, with larger soul than the common herd, advances from the ranks. It is understood as a challenge to single combat; and he is met by one of equal spirit. They meet, seize each other by the mandibles, and struggle for the mastery. The tide of war comes rushing on, and they are lost amid the thousands of combatants. To whichever side the victory incline, the repulsed despatch expresses for reinforcements. They arrive, and the battle is restored. Wo to the wretch that is taken prisoner! He is dragged away to death, or hopeless slavery,—for domestic servitude is not confined to the human race. The assailed, generally the weaker party, unwilling to trust to the issue of the battle, make instant preparations for the worst. Their most precious things, with their young, are hurried away from the danger, and sometimes almost ere the day is lost, they have laid the foundations of another commonwealth, where they hope the rage of war will not seek them out. Doubtless they have their Thermopylæ—their Austerlitz—their Waterloo. The spirit of a Bonaparte has doubtless dwarfed itself to the bosom of an ant. Man rises above the little mimic of his pride and his power, only when he learns to place his glory in the peaceful and the just. But we have not yet done with the ant. Many a farmer who prides himself on his flocks and herds, would find himself outdone by the insects he treads upon. Some species of ants procure the eggs of the aphis, watch their hatching, and nourish the young with food they do not

use themselves. But why? The farmer looks to the reward of his care, when the kine shall fill the brimming pail; and the ant to a sweet juice secreted by the aphis. Again, a species of the ant derives nourishment from another of the aphis tribe to be found in our gardens. They seem to have reached the idea of corporate if not of private property. An ant hill will claim exclusive right to the possession of the aphis on a particular shrub, and station sentinels to drive off all interlopers. Nay, they will even form a hollow ring of cemented earth around the stem of the shrub, where they herd their kine safe from the aggression of the insect-wolf. Facts innumerable and equally curious invite us to the study of animated nature.

The pleasures of science are pure and elevating in their character. It is extremely important for a young man to form a taste for solid reading. When he enters upon life, his blood is quick, his passions strong, and his appetites craving. The judgment is not yet matured to restrain the irregularities of the senses, and he is very liable to be hurried away into excesses, which lay the foundation for remorse and even despair. He must be occupied. He must have work—and pleasant work; for otherwise the body will get the mastery over him, and do mischief to his future life. At the same time he must be on his guard against the influence of the superficial and light reading of the day. The cast of our popular literature is pernicious to a vigorous and healthy tone of mind, begetting an unnatural craving for excitement, for strange horrors, for sudden and unexpected turns of fortune, enervating while it excites. Scientific reading, on the other hand, pushes the mind to investigation—gratifies its curiosity with wonders unsurpassed in fiction—while it elevates, by communion with the great minds of past ages, and with God

in his works. No man can be familiar with such men as Galileo, Newton, and others of like spirit, without venerating the qualities which give them their place in the world's estimation. They outstripped their age, and seem too far above us to belong to our race; but their weaknesses as men, bring them down to our level again. We cannot reach their heights in science; but we can cherish their spirit, and learn to respect ourselves, and answer the end of our being.

Science is the knowledge of the works of God. Wherever we turn—above, around, beneath, within—he has been there before us. From worlds to insects, he is the present God. The harmony of the heavens proclaims his power, his wisdom, and his goodness; and if we seek the aids of science, and place a leaf or a drop of water under the microscope, we are taught the same lesson in smaller characters, by the living creatures which people them. If in the contemplation of the higher wonders of the heavens, we feel our insignificance, and fear we shall be overlooked by our Maker, we shall regain our balance, when we see he does not forget to supply the wants of creatures so minute that the oak leaf is as broad as a forest, and the drop as a sea for their habitation. An incident in the life of Mungo Park will illustrate the elevating tendencies of scientific knowledge. Park had been plundered by robbers, left almost naked some five hundred miles from the sea coast, in the interior of Africa, sick, surrounded by wild beasts, and men hardly less savage. As he contemplated the gloomy prospect, despair of final success almost mastered him. He says—"At this moment, painful as my reflections were, the extraordinary beauty of a small moss in fructification, caught my eye. The whole plant was not larger than the top of one of my fingers, yet I could not contemplate the delicate conformation of its leaves and

capsules, without admiration. Can that Being, thought I who planted, watered and brought to perfection in this wilderness a thing so worthless, look with unconcern upon the situation and sufferings of a creature formed in his image? Reflections like these would not suffer me to despair; and disregarding both hunger and fatigue, I travelled forward assured that relief was at hand, and I was not disappointed." Yes, the flowers of the earth are the small print in which God writes many a lesson for our instruction. But where does he not teach us? The thrifty bee, in its humble labors, may rebuke the pride of knowledge, and learn us to reverence the power that quickens the instinct of an insect to wisdom and skill that man does not always reach. The bee, in all countries, constructs its cell of six sides; because if it had made them cylinders, there would have been much waste room between them; and if it had chosen the figure of three or four sides, the angles would have been too sharp for the young insect which is to occupy them. Now the cell of six sides leaves no room waste, at the same time that its angles are too broad to put the young insect to any inconvenience; therefore it is uniformly chosen. A floor or roof will be best supported by being formed of three planes, meeting each other at a certain angle. A mathematician, by the aid of the higher branches of science, ascertained that the angle should be 109° 23′. The bee actually forms the floor of its cells of three planes, meeting each other at an angle by measurement of 110°. Now who taught the bee, by mere intuition, what man only reaches, after ages of study, as among the results of the higher mathematics? Who but that being before whom humility is the condition of exaltation.

But we need not go abroad for illustrations of a present God in his works. The "house we live in," this taberna-

cle of clay, will furnish enough to occupy a life. Let us select a single illustration from the many. The blood is forced by the action of the heart into the aorta—the great artery—which conveys it, by its branches, throughout the system. The arteries are elastic, yielding to the current of life, and then by their contraction aiding to force it onward to the extremities. Were they not elastic, but unyielding pipes, there is no material known which could withstand the wear of the living current from the heart. Wherever the arteries loose their elasticity, they give way before the pressure, and the force of the blood destroys muscle and bone in its way, producing the disease called *aneurism*. The necessity of their elasticity is clear. It will be perceived at once, that the contraction of the artery will tend to send the blood back to the heart, as well as to propel it to the extremities. To prevent this, we find a valve placed in the aorta, which opens for the passage of the blood, but closes against its return. As the valve forms a ring, within the artery, we should naturally suppose that it would offer an impediment to the course of the blood. But such is not the fact, and the reason may be illustrated thus. If a barrel of water be bored in its head with an auger, we may observe that the stream which flows out is less in circumference at a little distance from the barrel than at the opening itself. The water within presses on all sides outward; the currents which compose the stream pass out in different directions, crossing each other at a short distance from the aperture. Where they cross, there is no unoccupied space, as at the opening, and the jet is less. Now the valve in the aorta is placed just where the stream gushing from the heart would naturally be the least, so that it does not impede the current of the blood. We are indeed fearfully and wonderfully made, and carry about with us the constant proofs of a present God.

The facts which have been brought to notice, are a few, among numberless others, equally worthy of attention. No man can give himself to the study of nature, without finding food for his mind. He has the knowledge which shall delight his youth, grace his manhood, and, next to religion, cheer his age. And more; in commencing with nature, he acquires a growing resemblance to nature herself, in a mind well balanced, peaceful, happy. The very agitation of his spirit will be but the natural effort of a spirit under the control of sound laws, to regain its equilibrium. The book of nature, too, is but the preface to the book of grace. Or rather, it is the first volume of the revelation of himself which God has made, with the promise of a second. In itself, it is incomplete—a fragment—a beginning without an end. It finds its completion in the Bible. The book of nature prompts us to inquiries, which find no answer in its pages; but it refers us to another, fuller, clearer revelation of truth, for an exposition of the great end of our being, and the means of attaining it. The book of nature, by its assertion of the same truths with the Bible, directs us to God as their common origin, and prepares us to receive in faith the higher truths of the scriptures, unrevealed in nature itself.

These remarks cannot be closed better than in the language of Kepler. He says—"As men enjoy dainties at a feast, so do wise souls gain a taste of heavenly things, when they ascend from their schools to the universe, and there look about them. He who has discerned the frailty of human affairs, will aspire heavenward from earth. He will begin to set less value on what appeared to him most excellent. He will esteem God's works above all things, and in the contemplation of them he will find a pure enjoy-

ment. Great Artist of the world! I look with wonder on the works of thine hands, and in the midst, the sun, the dispenser of light and life. I see the moon and stars strewn over the infinite field of space. Father of the world! what moved thee thus to exalt a poor weak little creature of earth so high, that he stands in light a far ruling king, almost a God, *for he thinks thy thoughts after thee.*" Yes, we see what God has made, how he has made them, and why; and we think his thoughts after him.

[redacted]

SEMI-MONTHLY RECORD.

History of Organs.—The word *organ*, as is well known to etymologists, signifies simply an instrument; and in that sense it appears to be used in several places in our translation of the Bible. When first applied to the instrument which now bears this name, the plural, organs, was applied to a single one, as it was a combination of numerous instruments of music in one machine.

The first organ mentioned by old writers is the *hydraulicon*, or water-organ; but of its nature we are wholly ignorant.

A Greek epigram, supposed to have been written in the fourth century, thus describes the organ:

"I see reeds of a new species, the growth of another and a brazen soil; such as are not agitated by our winds, but by a blast which rushes from a leathern cavern beneath their roots; while a robust mortal, running with swift fingers over the concordant keys, makes them smoothly dance, and emit melodious sounds."

The wind organ is supposed to have been introduced into churches in 670, by Pope Vitalban. Greece claims the honor of its invention.

Before the tenth century, organs had become common in Europe, and had been introduced into England. They must have been of very cumbrous construction, however, by the following versified description of one erected in 951, for the bishop at Winchester:

> "Twelve pair of bellows, placed in stated row
> Are joined above, and fourteen placed below:
> These the full power of seventy men require,
> Who ceaselessly toil, and plenteously perspire,
> Each aiding each, till all the wind be pressed
> In the close confines of the incumbent chest,
> On which four hundred pipes in order rise,
> To bellow forth the blast that chest supplies."

This organ had but ten keys, with forty pipes for each key. It is supposed that the seventy bellows blowers, instead of keeping their bellows in action during the time of performance, filled the chest with wind previously to the performance, and then left it to be let out at the discretion of the player. The keys are said to have been five or six inches broad, and must have been pressed down with the fist.

It was not till the fifteenth century that organs were so far perfected as to admit of playing with both hands; nor did their compass exceed two octaves, till the twelfth century. Registers, without which a variety of stops could not be formed, were not invented till about the year 1600.

Education and Learning.—It is useful to make a proper distinction between these terms, too often regarded as synonymous. Learning is the mere acquisition of knowledge; education includes that discipline of the faculties which enables us to make use of it. Two elements are an especial part of this discipline—system and application. Without order in the arrangement, mere knowledge is as piles of lumber; valuable indeed, intrinsically, but requiring to be sorted out, and sawed up, before it can be applied to any purpose. Without a habit of steady application, all acquirements must be superficial, and the direction of them to practical purposes uncertain. He whose strength barely enables him to lift from the ground a heavy bar, must be unable to support it so firmly as to use it to advantage as a tool. And so it is with the mind whose powers are so weak that they are with difficulty applied to the labor of successful study. That which is hardly grasped is with still more difficulty made use of. Thus it is that a man may be learned, and not know how to use his learning; and another, with less learning, succeeds much better, even in cases where learning is especially required. The latter is provided with a spade and shovel, with which he digs for what he has not got; and hardly fails of finding it. The former understands the veins of the mine, where the gold lies, but he has not learned to use the miner's tools.

VEGETABLE PHENOMENA.—Some of the operations of vegetable life bear a strong resemblance to manifestations of electrical agency. It would be, perhaps, going needlessly out of the way to venture to ascribe the apparently spontaneous motions of some plants, such as the *mimosas*, and particularly the *hedysarum gyrans* of India, to this cause, although they may possibly be dependant on it, while we can refer to phenomena in which the analogy is so much more striking. The flowers of the *tropæolum*, and a few other plants, whose flowers remain open in the evening, have been observed to emit faint flashes of light at that period. Some of the *arums* manifest a sensible increase of temperature, at the time of the expansion of the flower. Are not changes of temperature, both in the atmosphere and elsewhere, always accompanied by or dependant upon electrical changes? It is an opinion of some, that the growth of vegetables is directly promoted by electrical agency; and that it is at least indirectly so, perhaps we have no need to doubt. We hope, however, that experiments elucidating the degree and nature of this influence will ere long be made.

BULBS.—A bulb, instead of being a root, as it is commonly denominated, is a species of subterranean or radical bud, being in effect, the only bud of those plants which are said by botanists to be stemless; that is, which do not shoot up a stalk or trunk, bearing both leaves and flowers. The bulb, in these plants, is the embryo stump, or germ of such a stem, from which the leaf and flower stalks proceed. One of the most curious examples of this conformation is afforded by the *Colchicum*, or autumnal crocus, of Europe. Its bulb becomes the winter quarters, not only of the leaves which are to shoot up in spring, but of the unripened fruit; for the blossom appears so late in autumn, that the fruit has no time to ripen; but as the flower is seated directly upon the bulb, and the germ, below, is concealed within it, it finds there a safe protection, till the warmth of the spring matures it, ready to be sown, to spring up and to flower, like its parent plant.

An Argument for Science.—It is of the highest importance that, in the manufacture of articles of extensive commercial use, their nature, and that of the operations by which they are formed or prepared, should be scientifically understood. The evils of intentional fraud, which, though they cannot be too much deprecated, are ever liable to occur, ought certainly not to be augmented by those of ignorance. From researches made by Prof. Beck, of the University of New York, in relation to the manufacture of potash for commercial purposes, in that state, it appears that this article is extensively adulterated by the addition of substances, such as lime and common salt—especially the latter—which, though they really deteriorate it, are ignorantly supposed to facilitate the process, and improve the potash. It even appears that patents have been taken out for some of these absurd and injurious methods of manufacturing. One such fact is worth more than twenty theories, in regard to the general diffusion of scientific knowledge.

Creosote.—This is a vegetable principle which has been discovered by Dr. Reichenbach—it being the essential principle of the pyroligneous acid, well known for its antiseptic properties. It is an oleaginous liquid, colorless, transparent, and powerfully refractive. Its odor is very penetrating and disagreeable, resembling that of smoked meat. Its taste is very caustic and burning. The most important property of creosote is that of retarding animal decomposition. Fresh meat, and even fish, soaked for a quarter or half an hour in a solution of creosote, is incapable of putrefaction, and may be dried completely in the heat of the sun. Dr. Reichenbach hence concludes that it is to the presence of creosote that smoke owes its property of preserving from putrefaction; and he supposes, with great reason, that this substanee will become of great value in the preservation of meat for the use of ships at sea, and in the army; and even in domestic economy, when a method shall be discovered of removing from the meat the disagreeable odor which the creosote communicates to it.

A Curious Spring.—A modern traveller gives the following account of a hot spring situated in the neighborhood of Smyrna:—"The springs rise in the bed of a mountain stream, and their localities are indicated by the vapor which hangs over their surface. The temperature varies from 100° to 130° F.; and I was surprised to see fishes swimming about with perfect unconcern, in water so hot that I could barely keep my hand in it a few seconds at a time. Upon reaching my hand to the bottom, however, I discovered that the water was there scarcely above the ordinary temperature, owing to its admixture with the cool current of the mountain stream. The jet of hot water flows from the side, or near the bottom of the little excavation, and immediately rises to the surface, in consequence of its elevated temperature, while the cool water falls to the bottom; and I was enabled to prove, by direct experiment, that there were successive layers or streams of water, of various degrees of temperature."

Taking Casts of Medals.—Application has been made of the tannate of gelatin to the above-mentioned purpose. It is obtained by adding a decoction of gall-nuts, sumac, oak-bark, or any substance containing tannin, to a solution of glue or isinglass in water. It is fibrous, and nearly insoluble. When moist, it is elastic. When exposed to the air in thin layers, it hardens.

The Dry Rot.—This disease, (so called,) in timber, says a writer in Loudon's Architectural Magazine, ought to be designated a decomposition of wood by its own internal juices, which have become vitiated for want of a free circulation of air. If you rear a piece of timber in an upright position in the open air, it will last for ages. Put another piece of the same tree into a ship or a house, where there is no access to the fresh air, and ere long it will be decomposed. But should you have painted the piece of wood which you placed in an upright position, it will not last long, because the paint having

stopped up its pores, the imprisoned juices have become vitiated, and caused the wood to rot. Nine times in ten, wood is painted too soon.

If you admit a free circulation of air to the timber which is used in a house—which is no difficult matter—and abstain from painting that timber till it is perfectly seasoned, you will never suffer from what is called dry rot. And if the naval architect, by means of air-holes in the gunwale of a vessel, (which might be closed in bad weather,) could admit a free circulation of air to the timbers, and if he could abstain from painting, or doing over with turpentine, the outer parts of the vessel, till the wood had become sufficiently seasoned, he would not have to complain of dry rot.

Bone Caverns.—In several parts of the world, are caverns filled with bones of various species of animals. Some of them are bones of creatures too large to have entered the mouths of the caves in which they are found—such as the elephant; and which have never been known to inhabit the countries where their remains are found. The following is Cuvier's description of these caverns in Germany:—"Numerous grottos, brilliantly decorated with crystalline stalactites of every form, succeed each other to a great extent, through the body of the mountains, communicating together by openings so narrow that a man can hardly proceed by crawling on his hands; yet with their floors all bestrown with enormous heaps of bones of animals of every size,—forming, undoubtedly, one of the most remarkable phenomena which the fossil kingdom can present to the meditations of the geologist."

Water Proof Fabric.—A patent has been obtained in England, for a water-proof composition, applicable to cloths, prepared in the following manner:—Half an ounce of isinglass is to be dissolved in a pound of soft water; one ounce of alum in two pounds of water, and a quarter of an ounce of soap in one pound of water. After straining these solutions, if neces-

sary, they are to be mixed, and simmered over the fire a short time, and the liquid used hot. For lighter fabrics, the composition is varied as follows:—One quarter of an ounce of isinglass to a pound of water; three ounces of alum to three pounds of water; half an ounce of soap in an ounce and a half of oil of turpentine, mixed with a pound and a half of water; one ounce of fine glue in a pound of rain water; one ounce of gum arabic to half a pound of water. The alum, glue and gum, after being separately dissolved, are to be mixed, and the soap added some time afterwards. These ingredients must be mixed hot.

Science of Agriculture.—Scientific agriculture is far too little attended to among us. The nature of soils is little understood—hardly ever chemically; and the rotation of crops, when practised, based rather on the principles of convenience than science. And yet in no department of labor, perhaps, is a greater variety of scientific knowledge demanded, than in the cultivation of the soil. Chemistry, geology and botany, pursued to a greater extent even than they are taught in our schools, ought to be the narrowest limit to the studies of the scientific farmer. But where shall we find such an one, save perhaps one or two in the vicinity of our cities, or within the influence of a horticultural society? And where any established principles of science are acted upon, it is to be feared they are directed too exclusively to the single object of increasing the quantity of the products of the soil, with too little regard to their quality. A treatise, however, instead of a solitary paragraph, is needed on this subject.

Shower of Seeds.—In Persia, near Mount Ararat, there fell in the month of April, 1827, a shower of seeds, which, in some places, covered the earth to the depth of six inches. The sheep ate of them, and a tolerable bread was made of them. The French ambassador in Russia, obtained some specimens of this grain, and sent them to Paris, where they were examined by Messrs. Desfontaines and Thenard, and determined to be lichens of the genus *lecidea*.

The Cuttle Fish.—When full grown, this singular marine animal measures two feet in length. It has eight long arms, which are beset, on their inner surface, with numerous round, concave cups or suckers, which adhere forcibly to whatever substance the animal chooses to attach itself. One of the most curious characteristics of the cuttle fish is, however, that it is furnished with a receptacle of an inky black fluid, which it discharges at pleasure through a hole in the breast, blackening the sea for a considerable distance about it. This liquid, when collected and dried, is capable of being redissolved in water, forming a beautiful and durable ink; and the Chinese preparation called Indian ink, is supposed to be obtained from this substance.

The Climate of England.—It is a remarkable circumstance that, although in a latitude ten degrees higher than ours, and consequently corresponding to that of some portions of Canada, the climate of England is so much milder than our own, that flowers may be found blooming in the open air, at intervals, throughout the winter.

Tea.—A successful attempt in cultivating this plant is said to have been made at the West. So various is our climate, that numerous other productions of different parts of the earth, which are now brought at much expense from a distance, will probably in years not far distant, find here a genial soil.

The Moral Reformer.—This work is evidently growing more popular, and the principles which it advocates becoming better understood. Dr. Alcott is doing all he can to diffuse sound knowledge in relation to Physiology and Hygiene, and his work will undoubtedly live to be a standard one, on these subjects.

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HISTORY OF PEACE SOCIETIES.

BY WILLIAM LADD.

Views on the abolition of war. Two different opinions.

General View of the Subject.

The operations of Peace Societies in the United States and in Europe, have been of a nature so mild and gentle that they have attracted but little notice. Many, even of those who considered war to be a tremendous evil, both temporal and eternal, have considered it an irremediable evil, under which mankind are destined to groan, until God, by the exercise of some miraculous power, scarcely inferior to that by which he made the world, shall re-model human nature; and thus, without any agency of ours, convert the sword into a ploughshare, and the spear into a pruning hook.

There are others, however, of a different opinion, who think that we are to expect no new dispensation—that the means we already have in our hands are fully sufficient to work this important change, and that moral revolutions must be effected by moral means; and, in short, that everything which ought to be done can be done—that there is no obstacle to any assignable good, of a moral nature, which zeal and perseverance cannot remove. But they think, also, that there is no need of any *special effort*—that the ordinary preaching of the gospel, without any distinct denunciation of war, as unchristian, will ulti-

mately produce such a state of purity and holiness in the world, that wars will cease of themselves. These look upon the abolition of war as an end, and not as a means of producing a state of purity in the church and throughout the world.

There is another set of men, who differ from both of the above mentioned classes. They differ from the class first mentioned, by believing that the custom of war *may be* abolished; and they draw their arguments, first, from prophecy, which plainly and unequivocally predicts that the time shall come when the nations shall learn war no more; and secondly, from history, which informs us that many strange customs, which once existed in the world, have already been abolished, such as the judicial combat, the torture of criminals and witnesses in a court of justice, persecution for conscience' sake, and many other customs, which were once common to the whole of christendom, but now have ceased throughout the whole world. They allude also to more modern customs, such as the slave trade, so lately thought to be a lawful calling, that some of the best and most pious men in modern times have engaged in it, though it is now highly reprobated in those very countries which once carried it on with the greatest avidity; and is now so far from being tolerated, that it is classed with piracy, and held up to the detestation of mankind. They allude also to the manufacture and sale of ardent spirits—a business which some of our most worthy and pious citizens lately engaged in; and though some of our best men may yet be engaged in such business, they are looked upon as singular exceptions, and are exposed too much to the scorn, and receive too little of the pity of their fellow citizens, who ought to have compassion on the weakness of human nature, and make more allowances for the prejudices of educa-

tion, considering that they also are encompassed by the same infirmities, and should correct themselves before they despise others, and pull the beam out of their own eye, before they attempt to pluck the mote out of their brother's eye. Perhaps they themselves are tolerating a custom as detrimental to the interests of their fellow creatures, and more barbarous, than the one they condemn.

The above mentioned class of men differ also from the second class, in believing that a *special effort is necessary* to the abolition of the custom of war, for the following reasons:—First, because ministers of the gospel do not, generally, preach against war. There are, of late, some praiseworthy exceptions, it is true; but taking the whole number of ministers of religion in christendom, there is not one in a thousand—probably not more than one in ten thousand—who preaches against war. On the contrary, it is probable that there is not more than one minister in a thousand, who does not justify war in some shape or other. To suppose that the ordinary preaching of the gospel will abolish the custom of war, is to allow that the gospel condemns war; but if that condemnation is never heard in the preaching of the gospel, it can have no effect. Secondly, there are men who do not believe the gospel, and never hear it preached. Such a man was Voltaire, who saw clearly the folly of war by the light of nature only, and denounced it accordingly, and denounced the christian religion as upholding the murderous custom.[1] He judged of the christian religion by the conduct of its professors, and not by the principles of its founder. And there are men who, though they have a speculative belief in the truths of revelation, are governed by its dictates, only through the example of its professors. These must be addressed through their philanthropy, by describing the awful waste of life, the sufferings and

misery, not only on the bloody field of strife, but in the military hospital and prison; and the woes of private life occasioned by war, the groans of the widow and the anguish of the orphan, the sigh which bursts the heart, and the tear which scalds the cheek, must be brought out to their observation. They must be addressed through their desire to see their country wealthy and flourishing; through their just notion of political economy, by showing them the vast amount of wealth uselessly wasted in war —wealth which must be replaced by the hard hand of labor, and abstracted from the mouth of poverty—wealth which, if judiciously expended, would reticulate the whole country with railroads and canals, and give a school house to every hamlet, and an academy to every village, and send the schoolmaster abroad into every dwelling. They must be addressed through their love of liberty and independence, while their attention is directed to a Cæsar, a Cromwell, and a Napoleon, who have waded to empire through a sea of blood, and enslaved their own country, by the armies which have been raised for its defence.

As another argument for *a special effort*, and the formation of societies to forward the abolition of the custom of war, the friends of this measure appeal to history. The formation of voluntary associations for the accomplishment of any moral purpose, is, like the steam engine, of modern invention, and they have been as powerful in morals as the other has in physics. If the invention of the steam engine has increased physical power almost indefinitely, the invention of voluntary associations has increased moral power no less. How slowly moved moral power before the invention of voluntary associations! What would Sharpe, Wilberforce and Clarkson have accomplished toward the abolition of the slave trade, had they not been assisted by voluntary associations?

By the aid of voluntary associations, in a short time, public opinion was so changed, that the British government was compelled, not only to give up a lucrative branch of commerce, but to expend millions, to subsidize other countries, to get their consent to a general abolition of the traffic, and also to incur a debt of twenty millions of pounds sterling, to compensate the slave-holders in their colonies for their supposed loss of property; and this too while the nation was groaning under the weight of an immense debt of over eight hundred millions of pounds sterling, brought on it by war. All these great events have been brought about, in England, mainly by the power of voluntary associations, with but very little help from the pulpit. It was mainly by procuring and exhibiting statistics, showing the crimes and the horrors of the slave trade, that it was finally abolished—a business to which the pulpit was unsuitable.

If we look into our own country, we shall find the power of voluntary associations almost as wonderful. Long did the pulpit occasionally raise its voice against intemperance. We were getting on fast to be a nation of drunkards, and the derision of Europe. Voluntary associations came to the aid of the pulpit. They collected facts, poured forth their tracts and periodicals, and exhibited the statistics of intemperance to an astonished public. The unbeliever and the believer were equally alarmed. The christian, the philanthropist, the political economist, the moralist, and the statesman, all sprang forward to the rescue, and the nation is saved—or rather will be saved, when temperance shall have had her perfect work. Had there been no societies to print and distribute tracts, to employ agents, and to procure addresses, what would have become of the temperance cause? But the temperance cause has had great assistance from the

pulpit, without which its success would have been comparatively small. The pulpit and the press mutually assist each other.

If the pulpit asks the assistance of voluntary associations in other things, why should it decline that assistance in this cause only? What are our bible societies, tract societies, missionary societies, temperance societies, and Sunday school unions, but auxiliaries to the pulpit? The pulpit and the press must work together, like the two arms of a man. For either to work alone, is like a man working with one hand. He cannot ordinarily do half so much as a man with two hands; and voluntary associations are absolutely necessary to support the press, in urging forward any moral reform.

History of Peace Societies.

The first tract, composed professedly and exclusively for the cause of peace—except what may have been published by the Quakers—which ever appeared in this country, was written by a merchant of the city of New York, in the year 1809, and was entitled—"The Mediator's Kingdom not of this World." The author—who was a professor in the Presbyterian church—had his attention called to the subject by some interesting circumstances in his life, during the year 1804, and had sought for information in books, but found none, except those of the Friends, against whom he was then strongly prejudiced; and it was not until after mature deliberation of five years, that he ventured to appear before the public in the above named tract; which called forth a reply—the joint work of three *literary* men, one a *clergyman!*—entitled—"The Duty of a Christian in a Trying Situation." This was followed by a rejoinder from the merchant, who

labored incessantly among his friends and acquaintance, a few of whom at length openly avowed the pacific principles. As early as 1810, there was a deliberation on the expediency of forming a Peace Society, by a few friends to the cause; but the prospect of war was so threatening, that it was judged inexpedient *then*. In the mean time, the same gentleman wrote a treatise, entitled—"War Inconsistent with the Religion of Jesus Christ," which was published early in 1815. The war having ended, in August following the New York Peace Society was organized, consisting of more than twenty members, who did not know that any other Peace Society had ever been recommended. This, in order of time, is the first Peace Society in the world, embracing men of all sects, denominations and parties.

While this spirit was working in New York, like the leaven hid in the meal, a kindred spirit was operating in Massachusetts. The obstinate and sanguinary wars of Europe induced some serious and philanthropic men to inquire—"Shall the sword devour forever?" In consequence of these reflections, on Christmas day of 1814, a tract, entitled—"A Solemn Review of the Custom of War," by a venerable clergyman of the Congregational order, was published in Boston. On the 26th of December, 1815, the constitution of the Massachusetts Peace Society was signed by twenty-two members.

The Ohio Peace Society was formed on the 2d of December, 1815, by some gentlemen who had read the Solemn Review, and who supposed their society was the first of the kind.

How early the first proposition for peace societies was made in England, I am unable to state. But in July, 1815, it was published in a periodical work, called the Philanthropist. It was contained in a letter to the editor,

dated in April, probably before the Solemn Review was seen in that country. The "Society for Promoting Permanent and Universal Peace," was formed in London on the 14th of July, 1816. Thus four peace societies were formed in ten months, in regions far distant from each other, and probably unconscious of each other's existence.

In France, the "Society of Christian Morals" published its prospectus on the 15th of August, 1821. This society was formed through the instrumentality of a member of the Massachusetts Peace Society, then residing in France, and now an active member of the board of Directors of the American Peace Society. The object of the French society is, to dispose mankind "to abjure all anger, all hatred, all unhappy dissension—to love one another—to treat each other as brethren, and finally to seek and procure PEACE." The Duke de la Rochefoucault Liancourt is President; and among the Directors we observe the Count de Laborde, the late lamented Baron de Stael Holstein, and other men of distinction; and the society enjoys the "authorization" of the French government.

The Peace Society of Pennsylvania was organized in December, 1822, by the exertions of the late Rev. Henry Holcomb, D. D., author of several peace tracts, and pastor of the First Baptist Church in Philadelphia—who, like the venerable founder of the Massachusetts Peace Society, had borne arms in the American Revolution. In a sermon preached to his people January 19, 1823, speaking of belligerent christians, he says—"I implicitly, like many others, held their sentiments, until, at the pressing instance of a learned friend, I was recently led to examine them in the light of the gospel. The result was, my cordial renunciation of war, 'in its fairest form,' as by no means congenial with the religion of our common Lord." The board of managers presented their first report at the

semi-annual meeting, July 4, 1823, at which time the number of subscribers was 170; and on the same day, an auxiliary to the above named society, in *Georgia*, held its first annual meeting.

Beside these more important peace societies, others are or have been in operation, such as the Hibernian Peace Society in Ireland; and in Nova Scotia and Canada several peace societies have been formed. Also, in our own country, societies have been formed in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, and North Carolina, beside those already mentioned, and those of Pennsylvania, Ohio, and Georgia, and many others of a later date.

It must be evident to the most careless observer, that these dispersed and isolated societies would have but little effect on public opinion. Can it be expected that a society, confined to a village, a city, a county, or even a state, will revolutionize the world, and abolish a custom deep rooted in the depravity of the heart, and in habits almost coeval with the creation? They have, it is true, done much, and more than could have been reasonably expected; for they have furnished the germ of the national society, and are destined to supply, in a great degree, its future support. The necessity of an union of peace societies was clearly seen—an union which should eventually collect not only all the energies of all the peace societies in this country, but also in this hemisphere, and of all the nations of christendom, into one great simultaneous effort, which should, with God's assistance, overthrow that iron Colossus that has so long bestrode the world, and animated by the infernal spirit of him "who first made war in heaven," has trampled down the nations of the earth, and washed his steps with the blood of the brave, and watered his path with the tears of widows and orphans.

The first motion [illegible] this great object was made in the peace society of Maine, on the [illegible] of February, [illegible]. It was then voted—"That it is expedient to adopt measures for the formation of a National Peace Society;" and similar votes were passed by the peace societies of Portsmouth, N. H., of Massachusetts, of Windham county, of New York and of Pennsylvania. It was understood that the peace societies of Vermont and Rhode Island also concurred. The four first named societies appointed an agent to go to New York and Philadelphia, to confer with the peace societies there located, on this subject; in consequence of which a constitution, indited by the corresponding secretary of the Massachusetts Peace Society, was, with few alterations, adopted on the 18th of February, 1828, by the peace society of Pennsylvania, as a provisional constitution, which has since received the approbation of all the other peace societies in this country, to which it has been presented.

By this constitution provision was made for the first meeting of the American Peace Society, which took place at New York, on the 8th day of May, 1828; and on the next day the society was organized, and the above mentioned constitution, with a few alterations, was finally adopted. Since the formation of the American Peace Society, another national society has been formed at Geneva, in Switzerland.

Principles of the American Peace Society.

The principles of the American Peace Society may be learned from a circular letter, written in behalf of the board of directors, and published in the first number of the Harbinger of Peace, dated in May, 1828, from which the following is an extract:

"We believe the custom of war to be contrary to the principles of the christian religion, subversive of the liberty of mankind, and destructive to their happiness, —a horrible custom, which every one is called upon to do what he can to abolish. These truths we hold to be undisputed; and they are the foundation of our society. Nevertheless, we draw no dividing or distinguishing line. We do not, as a society, agitate the question, whether *defensive* war can be carried on on christian principles. We receive into our communion all who seek the abolition of war, whether they hold to the lawfulness of defensive war, or condemn all war in every shape—whether they allow a latitude of construction to the injunctions of our Saviour, or take the exact and strict letter of them. We endeavor to avoid all "doubtful disputation," and to walk peaceably with all who will walk with us, whether they go further, or not so far, as the majority of the society; and we open the columns of our periodical publications to all who choose, fairly and candidly, to investigate the subject of defensive war, but hold ourselves responsible for nothing which appears in our pages, which is not expressly authorised by this board. This we do the more readily, as we believe that public opinion, when rightly directed, is able to abolish all wars of aggression, and that will put an end to all controversy respecting defensive war, which we do not even attempt to define—for to define would be to decide. Tamerlane and Napoleon called their wars defensive; and all conquerors, from the one to the other, have done the same. *Such* defensive wars we condemn. When we shall hear of a nation waging defensive war without committing aggression, we may, perhaps, withhold our censure; and when we shall see a defensive war *carried on on christian principles*, we shall

certainly approve of it.* We will also allow christians, of every sect, to use their own peculiar *modes of expression* in these discussions, but we will not allow our publications to be the vehicle of the peculiar *doctrines* of any sect, or the arena on which polemic theologians may contend for victory; for as a society, whatever may be the opinions of individual members, we shall confine ourselves to the pacific precepts of Christ, our divine founder, and avoid all strife of every kind. We are not confined to any sect or denomination of christians, but ask the countenance, the encouragement, and the support of all. Neither have we anything to do with the fluctuating politics of the day. Our principles were promulgated by the song of angels, which proclaimed peace on earth, and good will to man; they soar far above the temporary and local affairs of states and empires; they are as extensive as the world, and lasting as eternity. Wherever breathes a human soul, we hail him brother. Whatever may be the color of his skin, or the articles of his creed, we delight to do him good, and to extend to him the peaceful principles of our blessed Saviour. We are not confined by geographical boundaries, natural or artificial, but seek 'the greatest good of the greatest number.'

"For this purpose, our OPERATIONS shall be directed to the collection and diffusion of light on the subjects of peace and war; the printing and distributing of useful tracts on those subjects; and a periodical publication, which shall be edited by a person appointed by this board, which shall be the vehicle of the society's communications to the public, in which shall be collected the light

* By this it was not meant to decide the question whether war ever *could* be carried on on christian principles, but to leave that to the decision of every man's conscience.

which is shed by foreign peace societies, news concerning the diffusion of pacific principles at home and abroad, of the decay of error, and the dissipation of those clouds of delusion, which have so astonishingly enshrouded a fallen world; which shall be open to all, of every name or sect, who shall advocate the cause of peace on earth and good will to man; to place the truth, the whole truth, and nothing but the truth of our holy religion in all its purity, before the eyes of our fellow creatures; to analyze the spirit of military glory, and detect its poisonous ingredients; to strip the casque and the gaudy habiliments from the grim demon of war, and expose him, in all his naked deformity, to the astonishment of his votaries; to search in the records of history for the causes of war, and to show their wickedness and frivolity; to portray the horrible consequences of war, and hold them up to the terror of future ages; and finally, to examine into the discrepancy between the warlike and the christian characters, and to show to our contemporaries, that their best interests exactly coincide with the precepts taught in the gospel of peace, and that man's happiness is, by a kind Providence, closely allied to his duty.

"If we are asked what are our EXPECTATIONS, we answer, that we hope, by God's blessing on the means he has granted us, by the assistance of foreign peace societies, and by the aid of the benevolent of every name and nation, to bring about a more pacific spirit among christians, than has ever before existed since the decay of primitive christianity—to create, both at home and abroad, in the public taste, a disgust of war and a relish for peace—to lessen the causes, and consequently, the frequency of war—to moderate its ferocity, and soften its horrors—to hold up to public execration the mercenary wretch who sells his blood and sinews to any tyrant who will hire

him to fight in any cause; and to banish him from civilized society, and thus to deprive tyranny of many of its tools; and war of some of its willing victims. We hope by the force of public opinion alone to increase the number of non-combatants, and to lessen the restraint laid upon them, and give greater security to their lives and property. We hope to effect such a change in public opinion, as will abolish paper blockades—lessen the enumeration of articles called contraband of war—abolish the practice of privateering—and establish the principle that free ships shall make free goods, and thus dry up many fruitful sources of war. We hope by the frowns and the threats of public opinion, to abolish the customs of impressment and conscription where they are already established, and to prevent them where they are not; and thus unnerve the sinews of war. We hope to increase and promote the practice already begun, of submitting national differences to amicable discussion and arbitration; and finally, of settling all national controversies by an appeal to reason, as becomes rational creatures, and not by physical force, as is worthy only of brute beasts; and that this shall be done by a congress of christian nations, whose decrees shall be enforced by public opinion that rules the world;—not by public opinion as it now is, but by public opinion when it shall be enlightened by the rays of the gospel of peace—a light which hath hitherto "shined in darkness, but the darkness comprehended it not." Then wars shall cease; the sword shall be converted into a ploughshare; peace societies shall be dissolved; or rather, mankind shall form one great peace society; and then the millennial morn shall dawn on a benighted world.

"If it be demanded, what are our PROSPECTS, with our feeble means, of accomplishing the gigantic but benevo-

lent work we have so fearlessly undertaken, we reply, that to effect great things we must attempt great things; that no one individual preliminary step which we have sketched, when considered by itself, would be thought so unattainable as the destruction of the inquisition, the reformation of the errors of the middle ages, or the abolition of the slave trade. Where are now the judicial combat, the trial by ordeal, witchcraft, exorcism, alchemy, and many other delusions which once existed in the church? The light has shone, and the shadows fled away. Public opinion was enlightened, and the customs were abolished. This change was effected by the action of mind upon mind—of opinion upon opinion—and since the invention of printing, by dispersing truth in tracts and treatises. By preaching and printing, Luther and Calvin reformed, not only those who fell away from the church of Rome, but also those who remained, many of whom, no doubt, were pious men, but they labored under a delusion like that of war; yet the reformation was more unlikely in the twelfth century, than the abolition of war is now. By speaking and printing, Wilberforce and Clarkson unclasped the clutch of avarice, one of the strongest passions of our nature, and as far as their own country is concerned, the slave trade was abolished; yet half a century ago, the abolition of the slave trade was more improbable than the abolition of war is now.

"The success of older philanthropists, points out the MEANS to be used by us, which are the same as those of other benevolent societies of the day; particularly those formed for the purpose of abolishing slavery, intemperance and duelling; the distribution of tracts, the formation of auxiliary societies, the public speaking of such ministers and laymen as favor our cause, and the prayers of christians. By these means the above named societies

longer to accomplish their objects, and we do the same; for there are no other means; laws alone cannot do it, as we have experienced in the case of duelling; and no one expects that they can cure intemperance, or that they *will* abolish slavery. "Law is the expression of the general will," and the people must be willing, before laws or treaties of any kind can be enacted or ratified. But what laws cannot do, opinion can; for opinion governs the law, and the press governs opinion, and opinion can and will abolish war.

"We rest our hopes on the march of intellect, the progress of improvement, and the gradual amelioration of the condition of the human species. Who shall set bounds to that improvement? Who shall check its progress until it reaches the goal which God himself appointed for it, when the sword shall be beaten to a ploughshare? Finally, we chiefly build our hopes on the ROCK OF AGES—on the promise of the immutable JEHOVAH, who has declared that the time shall come when nation shall not lift up sword against nation, nor learn war any more, and confirmed it with an oath, *for the mouth of the Lord of Hosts hath spoken it*, and given us the means of accomplishing that promise. Who, in this enlightened age and country, has the effrontery to say, that God will not perform his promise?

"It may be asked, do we expect that this prediction will be accomplished in our day? Perhaps it will—perhaps not. The thing is not impossible. *It depends on us.* An union of action among all the christians and philanthropists of the day would surely accomplish it, so far as christendom is concerned, provided the present favorable crisis be seized, and no war should break out to blast our prospects, before our principles come into general operation; for there is no moral difficulty which zeal

and perseverance will not overcome—there is nothing that ought to be done which zeal and intelligence will not do. But if the total abolition of war be too much to expect in one age, yet some progress may be made—some head of the hydra may be crushed—some limb of the upas may be lopped. It is our duty to sow the seed, and to leave it to God to appoint the reapers."

Constitution of the American Peace Society.

"Among the many sanguinary customs which have afflicted the world, no one has involved more crime and calamity than public war, and no one has been more repugnant to the spirit and precepts of the christian religion; consequently, no object of philanthropy can be more deserving of the attention and patronage of all who bear the christian name, than that of abolishing the practice of settling national controversies by a resort to the sword. Experience having shown, that *National Societies*, for philanthropic objects, are eminently useful, the subscribers agree to form a National Peace Society, on the following principles:

Article i.—The object of the Society shall be to diffuse light respecting the evils of war, and the best means for effecting its abolition.

Art. ii.—The funds of the Society shall consist of annual subscriptions, life subscriptions, donations of individuals, and contributions of auxiliary societies, and christian churches and congregations.

Art. iii.—The payment of two dollars or more, annually, shall entitle any person to membership—the payment of twenty dollars shall constitute a minister a member for life—any person who shall pay thirty dollars at one time, shall be a member for life; and any donor of

fifty dollars or more, shall be an honorary member of the society. Every annual subscription must be paid on or before the twenty-fifth of December of every year.

ART. IV.—Every subscriber shall be entitled to receive annually, such publications as the Society shall make the vehicle of its communications. Auxiliary societies, churches and congregations, shall be entitled to the value of two thirds of their contributions, in the tracts, or periodical publications of the Society, at the wholesale prices. Any religious society that shall make its minister, or any other member of it, a life subscriber, shall, in like manner, be entitled to receive two thirds of the value of the money it shall pay into the treasury; and females, who shall form associations to aid the society, shall be entitled to the value of the money which they may contribute, in tracts or periodical works of the Society, when required.

ART. V.—The business of the Society shall be conducted by a board of not less than twenty directors, who shall have power to supply such vacancies in their number, as may occur by death or resignation—to appoint such officers, agents or asssistants, as they may deem necessary—to appoint their own meetings, and special meetings of the Society, directing as to time and place, and to manage the funds, and all the concerns of the Society, and to add to their numbers.

ART. VI.—At the annual meeting, the directors and treasurer shall exhibit their reports, and the directors shall be chosen for the ensuing year, who shall appoint the time and place of the next annual meeting.

ART. VII.—The presiding officer of the Society, or any person having his proxy, together with one of the secretaries, and three other members, shall constitute a quorum to do business.

ART. VIII.—Each auxiliary society shall be entitled to

be represented at the annual meetings of the national society, by two delegates, who shall be ex-officio members of the board of directors.

Art. ix.—The object of the Society shall never be changed; but in other respects, the foregoing articles may be amended, and others added, at any regular meeting, which shall be duly notified, provided three fourths of the members present shall concur in the amendment or amendments, or the article or articles proposed to be added."

Prize Dissertations on a Congress of Nations.

At the annual meeting of the Society at New York, May 13, 1829, the board of directors offered a premium of thirty dollars for the best dissertation on the subject of "a *congress of nations* for the prevention of war, which dissertation shall specify the particular object of the congress, and the mode by which its stipulations may be enforced." At the next annual meeting, the same offer was renewed, and the time for receiving the dissertations was extended to January, 1831. There was but one dissertation offered for this premium, which dissertation was subsequently withdrawn, and was published at the expense of the Society, in 1832, under the signature of Philanthropos. In the course of the same year two individuals, in the city of New York, offered a premium of five hundred dollars for the best, and one hundred for the second best dissertations on the same subject. The judges appointed were the Hon. Messrs. Calhoun, Wirt and Story, who accepted the appointment. Afterwards Mr. Calhoun desired to be excused, and Judge McLean, of the United States court, took his place, by the appointment of Messrs. Story and Wirt. These three decided that the premium should be equally divided among five of

the candidates, but said nothing about the second best. This decision did not meet the views of those gentlemen who had proposed the premium, nor the terms of the offer, and the judges were desired to reconsider their judgment, and decide which *one* of the five should be considered the best, and which one the second best, but they declined doing so, and the Hon. Chancellor Kent, John Quincy Adams and Thomas S. Grimké were appointed as a new committee to award the prize, and accepted. The death of Mr. Grimké occurring, it was necessary to choose some one to take his place, and the Hon. Daniel Webster was chosen and accepted. Thirteen dissertations were selected from the best of those which were offered. Chancellor Kent has read them and passed his judgment, but has not divulged it, and the manuscripts are now in the hands of the Hon. Messrs. Adams and Webster for their decision. About fifty dissertations, in the whole, have been handed in, some of which would make an octavo volume, and the labor of reading and selecting has been great; but it is hoped that this business will soon be brought to a close.

Periodicals of the Society.

When the American Peace Society was first established, it had a periodical, entitled the Harbinger of Peace, consisting of one sheet, folded in 12mo, and covered. This was issued monthly, and continued three years, when it was exchanged for the Calumet, of two sheets every two months in 8vo. This form of the periodical continued four years, when it was relinquished for the American Advocate of Peace, of three sheets, published quarterly by Wm. Watson, Esq., Hartford, Connecticut, at one dollar a year.

Progress of the Society.

The society has enjoyed a slow, though continual advance since its first formation, and it has done more during the past year to promote the cause of peace, than it has ever done in any one year before. They have employed a clergyman, of very respectable talents and standing, as their travelling agent, who has lectured in the principal cities in New England. His object has been to enlighten public opinion by preaching and distributing tracts, rather than the formation of societies. Yet seven new peace societies have been formed, four male and three female, since the last anniversary. But this does not mark the extent of the progress of peace principles. If we look at the change in public opinion since the formation of the Society in 1828, we are astonished at its magnitude; for, although the operations of the society have been noiseless and quiet, they have been, nevertheless, powerful. Eight years ago, seldom did any clergyman lift up his voice, in the pulpit, against the custom of war; now, more than five hundred are pledged to preach at least one sermon a year in favor of peace. Eight years ago, there had been but one ecclesiastical body, in our land, which had passed any censure on war; now, almost every ecclesiastical assembly in New England, and many out of it, have given their testimony against war and in favor of peace. The friends of peace have also raised their own standard much higher than it was eight years ago. Then, few could be found to oppose all war in every shape; now many, if not most of the leaders of the American Peace Society, openly condemn *all* war, as totally inconsistent with the spirit of the gospel, though it has not been thought expedient to alter the exposition of sentiments with which the society commenced.

There are many who, looking at the precepts of the gospel alone, are convinced that the law of love is the *only* law for a christian, and therefore condemn violence of every kind, as exercised in war, offensive or defensive. These expect to prevail by the gradual influence of the christian religion on the hearts and consciences of men, setting an example themselves of non-resistance to evil, and endeavoring to persuade others, by the force of gospel truth, to follow their example, until wars become unpopular and cease of themselves. Others of the friends of peace do not raise their standard so high, but admit the lawfulness of violence for self-defence, in extreme cases. These appeal chiefly to the philanthropy of our natures, by setting forth the horrors of war; and they endeavor to calculate its enormous expense, and to show the poverty, vice, slavery and degradation which usually accompany it. They expect to convince men of the folly and unreasonableness of war, and place their hopes on a *congress of nations*, which shall take away all need of appealing to arms to settle national difficulties; and they suppose that public opinion, *when properly enlightened*, will alone be sufficient to enforce the decrees of any board of judges or arbitrators, appointed by such a congress. Notwithstanding this difference of views, the friends of peace move harmoniously along together, each laboring in his vocation to abolish a direful custom, which has existed from the time of the murder of Abel to the present day, but which, from the prophecies, from past experience of the passing away of other customs, and from the increasing light and knowledge of coming times, we have reason to hope, will be finally abolished.

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MONTHLY RECORD.

Measuring the Expansion of Solid Bodies.—This is an object the attainment of which, to a great degree of exactness, has ever been a desideratum. All thermometrical observations are based upon the expansion of matter by heat; but on account of the expansion, in unequal and unascertained rates, of the materials themselves of which thermometers are constructed, together with other causes of irregularity, their indications of the expansion of the body submitted to measurement, whether fluid, as mercury, in the common thermometer, or solid, as in the case of the pyrometer, are far from being accurate, or accordant in different instruments. Lieut. Mather, of the United States Navy, proposes a method of getting rid, in a great measure, of these causes of inaccuracy, in the admeasurement of the expansion of solids, by the following means, as described in the last number of the American Journal of Science:

Two points of comparison are obtained, of an invariable distance, by "making use of two bars of different metals, whose lengths are inversely proportioned to their expansibility, on the principle of the compensating pendulum; so that if both bars be equally heated, the shorter shall expand exactly as much in length as the longer." The object required is now easily seen to be ascertained; for if both bars are placed parallel, and against a fixed support at one end, the other ends will continually be equidistant from each other. Thus a standard is afforded, for comparison of the lengths, at different temperatures, of a solid bar, placed in contact with the apparatus; and by appropriate machinery, the degree of expansion may be measured.

Limestone a Substitute for Gypsum.—Large quantities of limestone, under the supposition of its being plaster of paris, have been used upon soils, in the western part of New York, with great effect.

DISTANCES OF THE SUN AND MOON.—At the rate of thirty miles a day, it would require more than twenty years to reach the moon, were it possible to do so, by travelling in a direct line towards it; and the world has not lasted long enough for one of its inhabitants to travel to the sun, at that rate. Even were a railroad constructed through the heavens, a locomotive could not reach the moon in much less than a year, going day and night; and if the voyage to the sun were attempted, the engine would be worn out long before they could arrive there, for the trip would occupy almost four hundred years.

THE AURORA BOREALIS.—The annual report of the Regents of the New York University, made in February, 1836, contains an interesting article on the aurora borealis, by Prof. Joslin, in which he makes the following conclusions, as the result of observations:

"That the temperature of the air is falling, and the atmospheric pressure increasing, on the day in which an aurora appears.

"That generally after an aurora, the atmospheric pressure falls, the temperature rises, and water, either in the form of rain or snow, falls within two days.

"That the air at the earth's surface, if not saturated with moisture at the time of an aurora, is much nearer than usual to the point of saturation."

He attributes the aurora itself to light produced by the crystallization of aqueous vapor in the upper regions of the atmosphere. "The production of light by crystallization," says he, "is a common occurrence, and has been observed even during the congelation of water." This theory is far more plausible than that of its being caused by the reflection of light from volcanoes, or from the polar ice. The Journal of Science says, "this theory supposes the aurora to be nearer the earth than facts seem to allow; and on this ground principally rests its improbability.

SCIENCE OF HUMAN LIFE.

BY SYLVESTER GRAHAM.

On no subject does more extensive and enormous error prevail, than exists in regard to human life, health and disease; and yet, almost every person seems to think that there is a kind of intuitive knowledge possessed by all, which enables each one to understand his own constitution, and what is good for him, better than another can teach him.

In regard to almost everything in nature, except human life, and health, and disease, mankind are ready to acknowledge that there are fixed principles and permanent laws, and established order and system.

If we speak of the science of astronomy, and assert that God has constructed the planetary system upon fixed principles, and arranged the several bodies according to precise laws, that the relative size, weight, distance, velocity, and everything else in regard to the whole planetary system, are regulated and governed by the most exact and permanent laws—every enlightened christian and theist will readily admit the truth of the assertion. Or if we affirm, that in the creation of our globe God ordained all things according to fixed principles, and that he has established unchanging laws which govern it in every respect, our affirmation will be promptly acceded to. Or if we speak of the science of chemistry, and declare

that all the molecular combinations and arrangements of matter are according to fixed laws, and that these laws always govern every chemical action and result with the utmost precision, here, again, the truth of our declaration will be acknowledged. If, also, we assert that God has constructed every mineral according to fixed principles—that the formation of every crystal is governed by established law, this, too, will be admitted. If we proceed yet farther, and affirm that in the vegetable kingdom, from the smallest thing that has an individual existence to the largest tree, all are constituted according to fixed laws—that the life, growth, health, and everything belonging to the nature, and properties, and powers of the vegetable, are governed by the permanent laws which the Creator has established and continually sustains, the truth of what we affirm will still be unhesitatingly allowed. And finally, if, ascending in the scale of creation, we advance to the animal kingdom, and assert that God has created every animal, and established all its properties and powers upon fixed principles—that even in the formation of the bones, and muscles, and nerves, and all the organs of the human body, with their mysterious and wonderful endowments, law, and order, and adaptation to special purposes and ends, prevail and govern everything—even here the truth of what we predicate will be admitted.

Thus, from the nice adjustment and balancing of revolving worlds, to the structure and operations of the organs of the smallest insect and the simplest vegetable—and even to the arrangement of the particles of matter in the formation of minerals, and all the combinations of the elements of nature, by which the various forms and properties of matter are produced, throughout the whole immensity of created things, mankind will readily admit

that an intelligent, and wise, and benevolent Creator has established laws, and that by virtue of the laws which he has established and continues to sustain, the forms, and properties, and powers of all material things are what they are. All, except the atheist, will frankly acknowledge that it is befitting a God of infinite intelligence, and wisdom, and goodness, that all the works of his hands should be established in order and harmonious system, and governed by precise and unchanging laws. And even he who denies the existence of a God, is forward to confess that eternal and unvarying laws reign in and over everything, and that by the energy of those laws of nature, all the forms and conditions of matter were produced and are preserved. Yet—strange to tell—when all these acknowledgments are made concerning the laws which govern the material universe and all material forms, if we turn to the higher order of God's works, in which he has associated with organized matter in human nature, organic vitality, and animal consciousness, and sensibility, and voluntary motion, and intellectual and moral powers, and affirm that human life, and health, and thought, and feeling, are governed by laws as precise, and fixed, and immutable as those which hold the planets in their orbits, and cause all portions of each globe to press towards its centre, and point the trembling needle to the pole, and govern all the molecular combinations, and arrangements, and aggregations of matter in the inorganic and organic world, mankind will, almost universally, without a pause for thought, deny the truth of the affirmation, and contend that human life, and health, and disease are matters of entire uncertainty, governed by no laws, and subject only to the arbitrary control of God, or the blind necessity of fate, or the utter contingency of accident.

They do not believe that there are any fixed laws of life, by the proper observance of which, man can, with any certainty, avoid disease and preserve health, and prolong his bodily existence; and they are confident that the experience of the human family in all ages has fully and conclusively demonstrated the correctness of their views.

In the same circumstances and habits of life, they affirm, one enjoys good health, and another is frequently or continually diseased—one dies early, and another reaches an advanced period of life; while people of very different, and even opposite circumstances and habits, experience the same uncertainties and share the same fate—some enjoying health, and others being afflicted with disease—some finding an early grave, and some attaining to old age; and in all circumstances and habits, the vigorous and robust often die suddenly in the spring of manhood, or the very prime of life, while the feeble and the sickly frequently drag out a protracted and miserable existence. Survey, say they, the extended mass of the earth, and we find the inhabitants of one portion feeding on the putrescent carcasses of dead animals; others, on noisome vermin and reptiles; others, on a mixture of animal and vegetable substance; others, on vegetables exclusively; and others, allaying their hunger, and to some extent supplying the alimentary wants of their natures, with unctuous earths. Some indulge freely in the use of tobacco—others, in opium—others, in arrack—others, in rum, or some of the numerous forms of alcoholic liquor; and yet, with these differences of dietetic habits, and all the difference of climate from the equator to the poles, we find, it is said, among all the different tribes and portions of the human family, about an equal share of health and disease, premature death and extended life. And while the Esquimaux feasts with gustatory

satisfaction and delight on his carrion flesh, and derives from it the most healthful and invigorating sustenance to his body, the Hindoo, with equal gustatory enjoyment and health, makes his repast on his dish of rice; yet, if the diet of these two be exchanged, and the Esquimaux be fed on the rice and the Hindoo on the flesh, both will be disgusted, and both will be made sick.

Thus, we are told, it is completely demonstrated by the experience of all nations and all ages, that human life, and health, and disease, are matters either of absolute fatality or perfect contingency; and that in regard to them, there is no fixed philosophical relation between cause and effect; and, therefore, the life, health, disease and diet of man, cannot be governed by fixed laws, nor made matters of systematic science.

This reasoning, at first view, appears forcible and conclusive; but when thoroughly examined, it proves to be entirely fallacious; and the more deeply and extensively we push our investigations on this subject, the more fully are we convinced that human life, health, disease, diet, and general regimen, are matters of as pure and nearly as exact science as mathematics. Indeed, the science of human life, or of human nature, is far the most profound and important subject that has ever occupied the attention of man; and in order to the most perfect understanding of it, a knowledge of all other sciences is requisite. In fact, it may almost be said, that the science of human life consists of the sum of all other sciences systematized into one; and the only reasons why the notions of mankind are so vague and erroneous on this subject, are, that they never study it as a science, and most or all of their opinions are the results of *feeling*, or what they miscall experience, rather than of deep reasoning and philosophical investigation.

Nor is it surprising that it should be so, when the nature of man as a rational animal, and the circumstances in which he is placed, and the influences which act on his natural and moral susceptibilities, are accurately considered.

In the rude state of nature, the wants of man are few and simple. If hungry, he plucks the fruit from the bough of the tree, or gathers some nutritious substance from the earth, and satisfies his want. If thirsty, he stoops to the clear fountain or stream, or with his hand, or with a folded vegetable leaf, lifts the pure beverage of nature to his lips, and answers the instinctive demand. If cold, he wraps his body in the skins of beasts; if oppressed with heat, he retires to the cool shade of trees. When the sun sinks below the western horizon, and darkness covers the portion of the globe which he inhabits, he throws himself upon the bosom of the earth, or on some rudely prepared couch, and sleeps till the returning light rouses him, fresh and vigorous, from his slumbers; or if he inhabits a portion of the globe where darkness prevails for months, he sleeps and wakes according to the instinctive demands of his nature. The apparent revolutions of the sun, the waxing and the waning of the moon, and the changes of the seasons, constitute his only chronometer.

In all this, it is manifest that the rational powers of man are little employed in investigating the adaptation of his diet and habits to the laws of organic vitality. Possessed of the instincts common to all animals, he *feels* his wants, and by the *feeling* is prompted, like other animals, to satisfy them; and in doing this, he is governed by those instinctive powers of smell and taste, which enable him with the utmost accuracy to discriminate between esculent and poisonous substances. And, if reasoning powers of a

higher order than those which are exercised by other animals are employed by him, it is in devising the means by which his supplies are procured, rather than in ascertaining the fitness of those supplies to the real constitutional wants of his nature.

As man becomes gradually removed from the simple state of nature, by the artificial habits and circumstances of society, he finds it first *convenient* and then *necessary* to possess those rude utensils, the earliest specimens of human art with which he prepares his food, and dips his water from the brook, and fits his clothing for his body. No sooner are these things considered *necessary*, than the supply of them becomes of nearly as much importance as food, and drink, and clothing. This, in time, leads individuals to devote themselves wholly to the manufacture of such articles as the wants of society demand; and *this* leads to an increase of skill and knowledge in the manufacturing art, and a consequent improvement of the things manufactured; and this reacts upon society, and accelerates its progress towards what are called the refinements of civic life; and this again, while it continually multiplies the artificial wants of man, increases the necessity for the supply of those wants; and the final result is, that the artificial wants of man become so numerous and so imperious, that a large proportion of the time and powers of every member of society is employed in supplying them; and in the progress of the development of this state of things, the several arts and sciences of civic life are originated and matured.

Thus, from the simple instinct of thirst, or the natural want of water, has grown the invention and manufacture of the boundless variety of cups, glasses, and vessels of every description, employed in containing water, tea, coffee, wine, and all other kinds of alcoholic and other

liquors used as human drink; and out of this same simple want has grown the manufacture of the numerous kinds of liquor drank by man: and out of the simple instinct of hunger, or natural want of food, has grown the manufacture of all culinary utensils, and all the dishes, tables, and other articles used in holding, preparing and serving up the food of man, together with all the devices and arts of cooking. And out of the want of clothing, which was at first supplied by the skins of beasts, has grown the manufacture of the innumerable varieties of articles, made of wool, flax, silk, cotton, furs, &c. &c.

In the progress of these arts, one want has created another, and caused a continual demand for the closest and most constant application of the mental powers of man to the investigation of the physical, mechanical and chemical properties of things, with reference to forces, motions, numbers, quantities, time, distance, &c., till mathematics, astronomy, chemistry, and all other human sciences, have been slowly developed and matured, and become themselves some of the most important wants of society.

But it is obvious, that in this general progress of things, by which new wants are continually and rapidly generated and multiplied, there is little to lead the mind of man to study the laws of human life, or to examine the dietetic and other habits and circumstances of civic life, with reference to health and disease.

The artizan who manufactured the first rude cup or goblet, probably never gave a thought to the question whether water or some other liquid is best adapted to the natural wants of man; and since him, the thousands who have been employed in the same line of art, have seldom, if ever, been led by their occupation, to inquire whether wine, tea, coffee, and other alcoholic and narcotic bever-

ages, are adapted to the real wants of the human body, or are consistent with the laws of life and health. On the contrary, the very employment and circumstances of every artizan, require the constant application of his mental powers to the principles and operations of his art, in order to his immediate success as an artizan, and to his ultimate pecuniary success as a member of society; and this is also true of almost every other member of society. The wants of civic life are so numerous, and constitute so important a part of the very texture of social and domestic life, that every man finds nearly his whole time and attention taken up in supplying them.

It is true that disease multiplies in society, in proportion as man removes from a pure state of nature, and becomes more and more an artificial being in his habits and circumstances—and this leads to the study of the healing art, and ultimately to the study of anatomy and physiology; but even here, the general tendency of things is far less favorable to the accurate and profound study of the science of human life than is generally supposed.

Disease always precedes the physician, and the sick are only concerned to know how they can obtain the most speedy relief from their sufferings. The question with them and with their friends is, not how they came by their sickness, or by what violations of the laws of life it has been induced, but by what remedies they can remove the disease and restore health.

The domestic therapeutics of the earliest stages of society is generally extremely simple, and is perhaps governed at first by the morbid cravings of the patient, by accident, and finally by experience. If by any means the disease is removed, the remedies and measures employed are carefully remembered, and used again when similar cases occur; and in this manner every tribe, and

almost every family, soon acquire their system of pharmacy, and their theory and practice of medicine.

As society advances and diseases become more numerous and frequent, it follows as a necessary result from the consequent order of things, that individuals become devoted to the study of remedies and to the care of the sick; and thus physicians originate. The office is, perhaps, more frequently, at first, confined to the priesthood, who employ with their simple remedies, an abundance of superstitious juggling, and incantation and exorcism.

In time, however, some master-spirit like Hippocrates rises up, and digests the chaos of crude elements into something like order and system. But it is obvious that, from the first rude origin of these elements to their systematic arrangement, everything is done simply with a view to *cure* the disease, and without any regard to its cause; and indeed the disease itself is generally considered as the direct and vindictive infliction of some benevolent or malevolent supernatural being or beings; and therefore in all the progress of the healing art, thus far, not a step is taken towards investigating the laws of life and health, and the philosophy of disease.

Nor after medicine had received a more systematic form from the plastic hand of Hippocrates, did it lead its votaries to those researches which were most essential to its success, and which its great importance to society demanded; but like religion and everything else in the hands of man, it became blended with the grossest superstitions, errors and absurdities. Hence from the earliest traditions of Egypt, until comparatively modern times, the history of medicine, with very limited exceptions, is a tissue of ignorance and folly, error and absurdity, and only serves to demonstrate the absence of that knowledge upon which alone an enlightened and successful system

of medicine can be founded; and to show to what extent a noble, and we might perhaps with propriety say *divine* art, can be degraded, and perverted from its high capabilities of good to almost unmixed evil, by the gross ignorance, and sensuality, and superstition, and cupidity of man.

In ascertaining and defining the symptoms of disease with reference to the application of remedies, some of the ancients certainly did much for the healing art, and they undoubtedly made considerable attainments in the knowledge of anatomy and surgery; but we ought to know that all this may be done with almost entire ignorance of the laws of life, and the true philosophy of disease. Still, however, it must be admitted, that with all the disadvantages under which he labored in regard to physiological knowledge, the therapeutic views of Hippocrates were such as justly entitled him to be called "the father of medicine."

In modern times, anatomy and surgery have been carried, perhaps, nearly to the point of perfection, and very great attainments have been made in physiology. The science of human life has been studied with intense interest and remarkable success; but this has been confined to the devoted few, while, even in our own day and in the medical profession itself, the general and powerful tendency of things is adverse to the increase and diffusion of scientific knowledge in regard to human life, health and disease.

Intent as all men are on present enjoyment, they are little inclined to practice present self-denial for the sake of a future good which they consider in any possible degree contingent, and will only consent to bear the cross when compelled by necessity, or when they find it the only means of shunning imminent destruction, or of

escaping from intolerable evils. Hence, so long as mankind are favored with even a moderate degree of health, they rush into the eagerly desired excitements of their various pursuits, and pleasures, and indulgences, and nothing seems to them more visionary and ridiculous, than precepts, and regulations, and admonitions, concerning the preservation of health. While they possess health, they will not believe that they are in any danger of losing it—or if they are, nothing in their habits or practices can have any effect, either in destroying or preserving it; nor can they be convinced of the universal delusion, that if they enjoy health, they have within themselves the constant demonstration, that their habits and practices are conformable to the laws of health, at least in their own constitutions. They will not, therefore, consent to be benefited contrarily to what they regard as necessary to their present enjoyment, either by the experience or by the learning of others.

The consequence is, as a general fact, that while in health, mankind prodigally waste the resources of their constitution as if the energies of life were inexhaustible; and when, by the violence or by the continuance of their excesses, they have brought on acute or chronic disease, which interrupts their pursuits and destroys their comforts, they fly to the physician—not to learn from him by what violations of the laws of life and health they have drawn the evil upon themselves, and by what means they can in future avoid the same and similar difficulties; but, considering themselves as unfortunate beings, visited with afflictions which they have in no manner been concerned in causing, they require the exercise of the physician's skill in the application of remedies by which their sufferings may be alleviated and their disease removed; and in doing this, the more the practice of the physician conforms to the

appetites of the patient, the greater his popularity, and the more cheerfully and generously is he rewarded.

When the Saviour was on earth, and by the exercise of divine power, removed the multifarious evils of gluttony and drunkenness and lewd sensuality, without laying any restraints on the appetites of the multitudes which he healed, his popularity caused the very heavens to ring with the shouts of hosanna which were offered to his name. But when he began to teach men how to keep the evil spirits out of themselves, and how to avoid disease of every kind, by denying their appetites and crucifying their lusts, and obeying the laws which are constitutionally established in the nature of man, the cry of universal and furious indignation was—away with him! away with him!

Some external forms of things have changed since that time, but human nature has, in all respects, remained the same to the present moment; and the physician of this day has to deal with the same appetites and passions which at one moment lauded to heaven, and at the next, consigned to an ignominious death, the infinitely holy and benevolent Jesus. As a prescriber of remedies and a curer of disease, he may be esteemed, and honored, and rewarded by his fellow creatures; but in the present state of society, were he to attempt to enforce those rules of life by which disease may be avoided and health preserved, he would soon find himself surrounded by the cry—away with him!—and poverty and neglect, or persecution, would be the reward of his labors.

And what to a truly enlightened and philanthropic mind would be still more trying than even neglect, and poverty, and persecution, he would be doomed to see his deluded fellow creatures flocking in countless multitudes

after every vile imposter, and becoming the infatuated dupes of every species of wicked and murderous quackery.

Everything, therefore, in the structure and operations of society, tends to confine the practising physician to the department of therapeutics, and make him a mere curer of disease; and the consequence is, that excepting the few who are particularly favored by their situations as public teachers, the medical fraternity, even of the present day, have little inducement or opportunity to apply themselves to the study of the science of human life, with that devotedness, and zeal, and perseverance, which the profoundness and intricacy of the subject require; while on the other hand, almost everything by which men can be corrupted, is continually presented to induce them to become the mere panders of human ignorance, and depravity, and lust; and if they do not sink their noble profession to the level of the vilest empyricism, it is owing to their own moral sensibility, and philanthropy, and love of virtue, and magnanimity, rather than to the discriminating encouragement which they receive from society, to pursue an elevated scientific professional career.

Thus we see that both the natural and acquired appetites, propensities and habits of man, and all the circumstances of life which act on his natural and moral susceptibilities, concur to divert his attention from the study of the science of human life, and fix it on present self-enjoyment, and on the pursuit of the means of supplying his natural and artificial wants. And hence he is left to *feel* his way to, or gather from what he calls experience, most or all the conclusions which he embraces, in regard to the laws of life, health and disease.

This source of knowledge is as utterly fallacious as it is delusively specious; and the more deeply and extensively mankind are betrayed by it, the more totally blinded

do they become to its treachery, and the more zealously and confidently do they contend for its validity.

Now what would be thought of a method of studying mineralogy or geology, in which the particular feelings or impressions of each student, leading to different, or perhaps to contradictory results, should be made the basis of procedure? or what attainments in the knowledge of the characters and properties of minerals could be expected from such a course? Yet it is very analogous to the manner in which everybody reasons in regard to human life, and health, and disease, and general regimen. Every person knows from his own *feelings* and *experience*, precisely what kind of constitution he has, and what agrees and what disagrees with it, and everybody knows exactly what agrees and what disagrees with his own stomach; and is taught by his own experience what is best for his constitution and his health, and strength, and comfort. And surely, if a lady has the headache, she knows her own feelings better than anybody else does; and if she drinks a good strong cup of tea, and the pain leaves her head, nobody ought to be guilty of so gross an insult to her understanding as to attempt to convince her that tea is a poison, and that her use of it is a principal cause of her headache, for she knows that she always feels better after drinking tea; and from fifteen or twenty years experience, she knows that there is no better remedy for headache than a good strong cup of tea; for she has been subject to the headache for nearly twenty years, and the frequency and violence of the turns have gradually increased upon her from the first, till she is now obliged to give up all business or pleasures, and take to her bed for the whole day whenever she has a turn, which is certainly as often as once a week, and sometimes

Feeling itself does not point to its own cause.

more frequent, and she has always found that tea is "the sovereignest remedy in the world for headache."

Who can reason against such facts as these, or have the temerity to advance a theory which contradicts the universal experience of mankind. We confess that the enterprise is an arduous and a daring one, and is cheered by no encouraging prospect, except the possibility that mankind can be undeceived in regard to the validity of their feelings and their experience, as rules of life.

We do not, however, wish to convince our fellow-creatures that they have no *feeling*, nor that they do not know when and how much they feel; but we wish to convince them that the kind and degree of their feeling, by no means teaches them what causes it, nor the principles upon which its existence depends. We are are willing to concede to the lady, that she knows best how her own headache *feels*, and that she knows it is relieved by a cup of tea. But does she know either the remote or immediate cause of her headache? Does she know the vital properties, and powers, and functional relations of the organs of her body, and does she accurately understand the healthy and the diseased affections and sympathies of those organs? Does she know the qualities of the tea in relation to the vital properties and functional powers of her system? Does she know the direct and the ultimate effects of the tea on her system? how it produces the pleasurable feelings, and how it removes the pain of her head? And does she know whether the very effects of the tea, by which the paroxysms of her headache are relieved, are not the principal source of her headache, and the main cause of the frequency and violence of the paroxysms? If not, what are her feelings and experience worth, to herself or others, as rules of life by which she

or any one can judge of the fitness of her habits to the laws of life and health? We answer—not a farthing. Nay, indeed, they are worse than nothing—mere delusions by which we are decoyed from step to step along the specious labyrinths of sensuality and suffering. And such, with rarely an individual exception, is the universal experience of mankind. We acknowledge that they *feel*, and that they know whether their feelings are pleasurable or painful. But do they know physiologically *how* or *why* they feel, and understand the relation of their feelings to the powers and laws of vitality, and to the condition and functions of the living organs? We acknowledge, that by virtue of a vigorous constitution, many may live years, and some even to what we call old age, in the enjoyment of ordinary health, in spite of habitual violations of the laws of life and health. But does this constitute an experience which proves the correctness of their habits? or at least, that those habits are not unfavorable to life and health, in certain constitutions? Most evidently it does not.

It has been justly observed by one of the most distinguished philosophers of modern times, that "men in their inductive reasonings deceive themselves continually, and think that they are reasoning from facts and experience, when in reality they are only reasoning from a mixture of truth and falsehood. The only end answered by facts so incorrectly apprehended, is that of making error more incorrigible. Nothing, indeed, is so hostile to the interests of truth as facts incorrectly observed." * And on no subject are men so liable to misapprehend

* Playfair's analysis of Bacon's Novum Organum.

facts, and to mistake the relation between cause and effect, as on that of human life, health and disease. Without the most profound physiological, and pathological knowledge and discrimination, it is not possible for them to avoid self-deception. They constantly mistake the *causes* of their feelings, and misunderstand the physiological and pathological character of the feelings themselves. And judging of the qualities of things by the feelings which they produce, and without considering that even the most baneful substances may be made the causes of pleasurable stimulation to depraved organs, they inevitably confound good and evil; their facts become falsehood; their inductions, erroneous, and their experience a tissue of error and absurdity, which serves only to mislead and to betray them.

Nothing is more certain, therefore, than that the only way by which mankind can attain to correct notions concerning human life, health, disease, regimen, &c., is to apply their intellectual powers assiduously to the study of human life as a science; and this will lead them, not as mere animals possessed of consciousness and sensibility, but as rational beings, over a most extensive and interesting field of research and investigation.

Could we seize upon vitality itself, and ascertain its essence, we might perhaps be able to reason from its intrinsic properties and powers to all conclusions necessary for our use, with a more limited extent of argument, and much less help from other sciences, than we now find requisite. But we know nothing of the essence of life, and therefore we can only know its peculiar properties, and powers, and laws, by accurately ascertaining the character of its manifestations and effects, with reference to the ordinary laws and properties of inorganic matter.

This necessarily leads us to investigate the laws and properties common to all matter, and as far as possible, to ascertain the primordial form and essential nature of matter itself, and this will prepare the way for us to ascertain the differences and distinctions between inorganic and organic matter, and thus enable us to find out the laws and properties peculiar to all organized matter, or all living vegetable and animal bodies, and the differences and distinctions between vegetable and animal bodies, and the properties and powers peculiar to all animal bodies, and finally bring us to the study of the particular anatomy and physiology of man.

This subject is of immense importance to every human being. Man finds himself upon the theatre of life full of susceptibilities, surrounded by innumerable influences, and acted on at every point, and he is continually conscious, not only of his existence, and of the action of surrounding influences, but of an unceasing desire for happiness. Has God implanted this desire as a fundamental principle of action in our nature, merely to tantalize us in the vain pursuit of what has no reality? or is the desire itself a living proof that our benevolent Creator has fitted us for happiness, not only in a future state, but here, in soul and body, and adapted everything within us and around us to answer this desire, in the fulfilment of those laws of life, and health, and happiness, which He, in wisdom and in goodness, has established in the constitutional nature of things?

Surely our heavenly Father cannot but prefer our happiness at every instant of our lives; and if we are not happy, it cannot be because he has not endowed us with the capability of being so, and adapted earth and all terrestrial things, to all that he has made us capable of being.

Our disquietudes, and diseases, and untimely death, must therefore spring, not from the fulfilment, but from the infraction of the laws of God, and it becomes us humbly, yet diligently, to endeavor to ascertain those laws, and to obey them and be happy, and thus fulfil the benevolent purposes of God, and glorify him in our spirits and our bodies which are his.

It is impossible to understand these things without a determined and persevering application of the mind. And for the sake of important knowledge, we must be willing to submit even to the drudgery of that application which, at first, is made only with the hope of being rewarded when the task is mastered, and hidden things are brought to light by penetrating diligence.

MONTHLY RECORD.

Cultivation of Forest Trees.—It is to be wished that the value of trees might be still better understood than it is, even by those who take the pains to plant the few that are planted. The time will come, when trees must be cultivated, not for ornament or for shade merely, but for all their various and important uses. Then we shall lament that those who planted forgot to plant for others, as well as themselves. Even now, our spontaneous forests are felled, faster than new ones can arise to supply the demand. It has been calculated "that every ship of the line requires all the good wood which can be found on fifty acres of woodland.; and the ships decay long before the forest can grow again." In France, the cutting of the forests, which supply nearly all their fuel, is conducted on a very rigid system of economy, enforced by law.

Beet Sugar.—This is a most important article of manufacture in France, and from what we can learn, is becoming still more so. Unlike many other vegetable products, for which we are often indebted to a single tree or plant, or a small portion of country, the saccharine principle is one of the most abundant in nature; and the question is, how it may be obtained purest and to the greatest advantage. The beet is represented to be one of those sacchariferous vegetables which yield their sugar with the greatest ease; and it is by nature adapted to culture in northern climates, which can reap no benefit from the cane.

Were the makers of sugar from the maple acquainted with methods of refining it, and could they furnish us with a pure, crystallized sugar, which we are left to presume the maple syrup is capable of yielding, they might perhaps be able to pre-occupy, in a measure, the ground which, we venture to

predict, will at some future day be shared by the manufacture of sugar from the beet. Experiment alone can decide the question of the respective advantages of these two branches of manufacture, when brought to a high state of improvement. No species of manufacture are more healthy, if we may so speak, to the national body, or more deserving of encouragement, than those which thus directly promote cultivation, which ought ever to keep up with, and even to go before manufactures, but which there is too much temptation, in the lucrative emoluments of trade, to neglect.

Chemistry applied to Agriculture.—This work, published some time since, ought to be in the possession of every intelligent cultivator of the soil. Agriculture, the first, the noblest and the most important occupation and source of national wealth, seems to have hitherto made less use of, and derived less benefit from the researches of science, than almost any other of the arts of civilization. The work before us is a translation from the French of Mr. Chaptal, a learned and practical agriculturist. Almost the only English work on this subject, is that of Sir. H. Davy. We have in the work of Mr. Chaptal an explication of the practical application of the principles of mineral and vegetable chemistry and vegetable physiology in the cultivation of the soil, with regard to the succession of crops, the improvement of lands, &c. Though written with particular reference to the agricultural interests of France, it will be useful everywhere; for the principles of science do not vary with climate.

Several important and interesting subjects relating to the connection of agriculture and political economy are discussed in this work. In conclusion, a variety of topics of the highest importance in domestic economy are treated of, together with the preservation of the products of the soil, and the manufacture of various articles from them. Most prominent among the latter is the manufacture of beet sugar, concerning which we have given some hints in another paragraph.

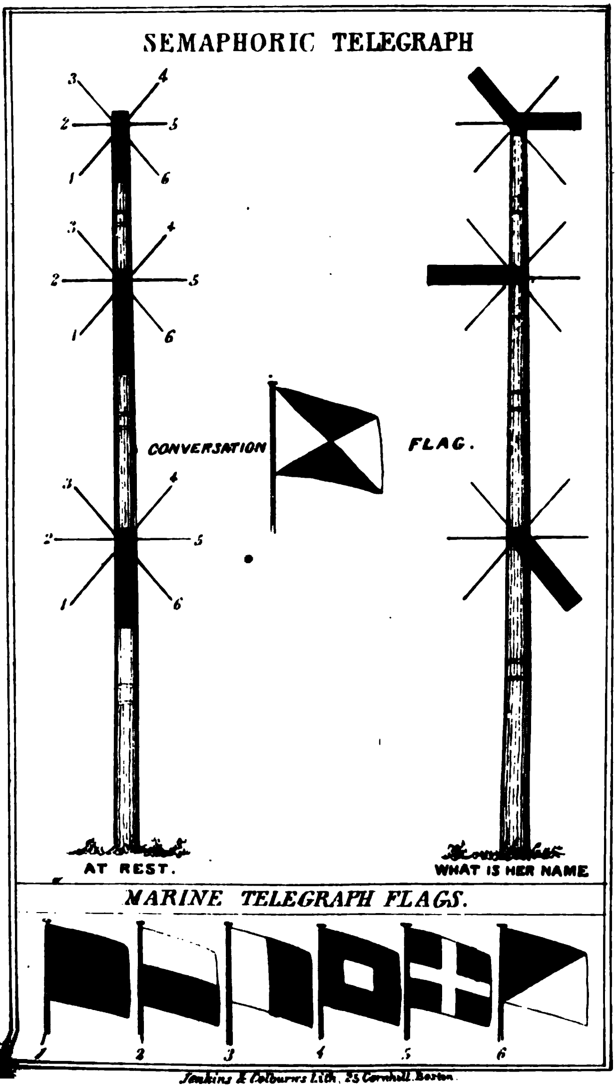
We only add, that we regret the countenance given by Mr. Chaptal to the use of fermented and distilled liquors, and wish, at least, that the false philosophy which, in our opinion, it inculcates respecting them, had been exposed by the translator.

Nothing Made in Vain.—Ignorance only could ever have dictated the sentiment that anything was made in vain—that ignorance which leads its victim to believe that he is the only object on which the good gifts of Providence should have been lavished, and, finding things in the universe which he can neither understand nor make use of, impiously to deem them useless, and made without a purpose. But he who considers the myriads of beings besides those of his own race, which are nourished by the hand of Providence, and the thousand purposes to be worked out in the great laboratory of nature, of the very existence of which, much more their need and means of fulfilment, he is ignorant, will never be hasty to conclude of anything, that it exists "in vain." It were strange indeed, if the Father of creation should reveal all his purposes to one of his feeble creatures, and teach his deepest mysteries to him, to whom his own existence is an inexplicable mystery. Science never fails to teach him who pursues it in the love of it, more and more to mistrust himself; and the farther onward he pursues its paths, the more insignificant does he feel himself to be, as he sees its intermin[illegible] fields spreading wider before him, beyond the very b[illegible] of which he does not seem to have progressed.

Lardner on the Steam Engine. Second American edition, with Notes and Additions, by James Renwick, of Columbia College. E. L. Carey & A. Hart, Philadelphia.—This, we hesitate not to say, is one of the best and most perspicuous and intelligible treatises which we have, on that masterpiece of modern art and ingenuity, the steam engine. The commodious size of this volume, and the valuable information with which its pages abound, ought to insure it a place in every library. Living as we do, surrounded almost by the

smoke of steam engines, a general acquaintance with their structure and history, at least, ought to form a portion of every one's stock of information. And, as we have said, we know of no better book than this, none at once so clear, and compendious, and within the means of common readers to obtain, on this subject.

Color of Flowers.—Out of 435 species of plants and flowering shrubs indigenous to our soil, in New England, including nearly all the most common species, bearing conspicuous flowers, 180 species bear white flowers, and 117 yellow. Only 90 are red, and 48 blue; and of the former, only about three or four bear proper scarlet, or brilliant red flowers; and there are said to be none native in England. If in the above estimate, the green, (or, in the language of botanists, colorless,) and inconspicuous flowering plants had been included, the proportion of showy flowers would appear much more inconsiderable.



Jenkins & Colburn's Lith. 25 Cornhill. Boston.

HISTORY OF TELEGRAPHS.

BY J. R. PARKER.

Words.	Languages.

A VERY learned French writer justly observes that "words are the bond of society, the vehicles of knowledge, the basis of the sciences, the depositories of the discoveries of a nation, of its knowledge, its cultivation, its ideas. The knowledge of words, or language, therefore, is an indispensable means of acquiring things."

Of languages there are two general classes, written and unwritten. The savages comprehend only the latter, because they never have been accustomed to the use of letters, but communicate their ideas by sounds, or through the medium of the ears. Among the class of written languages are those in which ideas are communicated by characters or signs addressed to the eye, with a pen, brush or types, flags or telegraph signals. This fact will doubtless call the attention to the great diversity of signs and modes adopted to hold communication.

It may truly be said that of all the ingenious inventions to hold intercourse, none exceeds in simplicity, and certainly none equals in rapidity, the telegraphic system of language.

The word *telegraph* is derived from two Greek words, *teele*, at a distance, and *grapho*, to write, or indicate by signs; as *telescope* is derived, in like manner, from the Greek words *teele*, at a distance, and *scopeo*, to see.

Another name is also taken from the Greek, *semaphore*, from *seema*, a sign, and *phero*, to bear or carry.

There are no means of conveying intelligence with a rapidity equal to that of the telegraph; * for with the exception of the scarcely perceptible delay at each station, necessary to repeat a communication, its rapidity may be compared to that of light itself.

A perfect telegraph system should be sufficiently copious to communicate, by signs, all that could be conveyed by writing. This art was not unknown to the nations of antiquity. Signals of different kinds have been employed from the earliest periods of history. They were sometimes addressed to the eye, and sometimes to the ear. The manner of communicating is variously stated; by fire signals, flags, shutters and arms, fixed upon a post, displaying a variety of positions, denoting the several letters of the alphabet, singly and conjoined. As far as the ancients were acquainted with it, we find mention made of it by Homer, Æschylus, and Julius Africanus. Livy, Vegetius and Plutarch state that the Roman generals used such signals; and they have been used among the Chinese, Scythians and Gauls, and almost all barbarous nations. Polybius invented a mode of indicating the letters of the Greek alphabet by the display of torches; but the communications were made between two stations only.†

We have no positive information that any methodized codes of signals were used in the fleets of the ancients, but such commanders as Themistocles and Conon must have directed their marine operations by so obvious a mode as by signals made by flags or lights. That flags were made use of is evident; for it is written that if the

* See note A. † See note B.

ship which carried Ægeus to Crete returned in safety, a white flag was to be hoisted.

In the reign of Queen Elizabeth, we meet with the first regular sets of signals and sealed orders to the commanders of fleets, which were to be opened and acted upon when a certain latitude was attained. James the Second, when admiral, was the first who introduced a system of methodized signals, by means of which, divisions of fleets, as well as single ships, could be directed to act in any specific manner. Previous to his time, the principles of co-operation, connected procedure, and change of position adapted to circumstances, were very imperfectly, if at all understood. When once an action commenced, every idea of regulating its farther progress was abandoned. The degree of naval science then practised became nearly useless; and daring resolution, and the physical power of grappling with the enemy, decided the fortune of the day.

The Duke of York, (afterwards James the Second,) first adopted a scientific formation of line, and an order of battle calculated for various situations in respect to the enemy, their number, and the state of the wind and weather. The Duke's fighting and sailing instructions, classed according to their various heads, were referred to by a specific signal pointing to each movement or manœuvre of the class. The ground work, resting upon unchangeable general principles, though it may have received many additions, and may have been simplified by the *numerical order of signals*, remains to this day as the basis of evolutions, and the germ from which has sprung the British naval code.

Le P. Hôte, in his *Art des Armées Navales*, printed at Lyons in 1727, has given a system of signals with sails, varying flags, and guns fired at slow and quick time, at night. Some of his signals were of a clumsy description,

such as the suspending a water cask from the yard arm, to indicate want of water, and a large hatchet, to show the want of wood or fuel. To express a *numeral*, he recommends hoisting up and lowering a certain flag, till the number meant was thus *counted out.*

Many years after, a species of day and night telegraph was known to have been put into operation by the Marquis of Worcester. It was constructed upon the lettering plan, but what were its form, and manner, and principle of operation, does not appear.

Monsieur Amontons, a Frenchman, recommended the holding up of large letters, to be viewed through telescopes. Dr. Hook was also the inventor of a land telegraph, with a dictionary, upon the numerical plan, dedicated to the Royal Society of London. Kircher also hit upon a similar invention; but a Monsieur de la Bourdonnais, a Frenchman, brought this plan to considerable perfection. The telegraphing of words and sentences was known to the ancients. But during the French revolution, which was prolific in everything that tended to develope the resources of the human mind, a report was made to the National Convention, by a Monsieur Chappe, of the modern telegraph. This machine consisted of an upright post, with a bar of wood, or balance beam, eleven or twelve feet long, moving on its centre across the top, like a scale beam, and having at each extremity shorter bars, called indicators, which likewise turned upon their respective centres. All the requisite combinations could be made, by placing the large and the smaller bars either horizontally or vertically, or at different angles with the horizon. The use of it was complicated.

Lord George Murray coustructed a six shutter telegraph, turned with pulleys connected with cranks below,

in such a manner that the whole surface or the edges of the shutters might be exhibited to the eye, according to the required signals. This shutter telegraph gives sixty-three combinations. Its practice and use have been superseded, in England, by the introduction of Sir Home Popham's semaphore telegraph, which consists of an upright post or mast, with two semaphoric arms moving vertically on their respective centres, one at the top, the other half way down; each arm being made to perform an entire revolution, and turning with facility and despatch, so as to take any position that may be required—differing however from each other in principle of motion, degrees of power and mechanical contrivance.

The principle of semaphores, or the projection of an arm from a mast, originated in France. Its powers depend upon the number of arms or wings attached to the mast. An extension of operations is effected by the addition of balls and flags. It includes three distinct principles: the first is the projection of an arm or wing from the top or the side of an upright post; the second is the construction or mechanical contrivance, by means of which the numerals are made, and the combinations formed; the third principle comprehends the limits of power furnished by the single and compound action of the wings.

It is very desirable that telegraphic communication should be rendered general or universal. The celerity of intercourse which would then be established would, in the abstract, confer incalculable benefit on mankind, and would be particularly subservient to the interests of commerce, and of all mercantile transactions, while science, philosophy and belles lettres would be materially aided by a speedy communication of discoveries and improvements tending to the advancement of human knowledge.

This friendly and social interchange of the results of study, and of projects of general utility, would strengthen the principles of civilization, would maintain a mutual good will, and, in cherishing the kindly affections of the heart, would be a powerful means of maintaining the relations of amity and peace among mankind.

Sensible of the operose and creeping tediousness of the lettering plan, and having fully experienced the manifest disadvantages and the total ineligibility of working by heavy and complicated combinations, in lieu of the ascertained simplicity of the numerical plan, I have established a rule that every telegraph station is to keep up its conversation signal, till the next station has been seen to take it up accurately; and as combinations are, as it were, a complex study, a person might, under such a perpetual exertion of thought on things differing but little, be apt not to remember precisely the combination, even on his own telegraph. By a constant, close, and strained attention, these errors and mistakes may not be so liable to happen; but this very necessary attention must, unavoidably, occasion the taking up of a great deal of time at any station along an extensive line. Besides all this, much time is comparatively lost in reading off the combination at each station, on the part of the observer at the telescope, who must frequently be obliged to repeat what must be nearly new to him, and to those working the telegraph. Thus it appears that, so far from accelerating communication by the use of troublesome combinations, it may be proved experimentally, that it is a mode not only more tedious, but much more liable to error and uncertainty than any other mode, independently of the increase of expense in enlarging the telegraph, and obscuring its visibility, of whatever description it may be.

The *numerical plan*, on the contrary, is so simple and familiar, that mistake is next to impossible. The persons employed have only to recollect the movements of the arms indicating the numerals, and they are set up in an instant, without hesitation or doubt; and where a telegraph is single, class and column are indicated in quick succession, and probably more quickly than combinations in any instance. An auxiliary arm for expressing the classes is particularly recommended. In this case, the operation will be beyond comparison, more convenient, more easy, and infinitely quicker, than *working by combinations*.*

The telegraph language is not to be confined to one nation, being founded upon the basis of numerals, which are almost a universal written language; telegraphic signs become easier than any other to be adapted to the different languages of the world. The French and English languages are so generally cultivated and known, that a telegraphic dictionary should be had, embracing those languages: these dictionaries, to be unexceptionable, ought to contain all the articles to be enumerated and exemplified. The first of the dictionaries of universal application must have an alphabetical arrangement of French vocables, phrases, sentences, and of all other useful articles, in columns of classes. In the column immediately attached, the precise translation of each French word would be inserted, without, of course, any alphabetical order. The second requisite Dictionary would be precisely the reverse of this, as the English words, phrases and sentences would be alphabetically arranged, in the first or left hand column, while the

* See note C.

French translation would be inserted in the contiguous right hand column.

In this case, each nation would be provided with two dictionaries. One party would know the French meaning of the marginal numbers telegraphed in the right hand attached column of French translation, while the other party would telegraph his answer by means of the Dictionary of French alphabetical arrangement, and the other party would find the import of each number telegraphed. French being more generally understood than English, all other nations might make use of the French dictionary of alphabetical arrangement, and the answer might be returned from the same dictionary. It will readily be seen, that by this simple expedient, foreign nations would be greatly benefited.

The use of marine telegraphic flags is of vast importance to a great commercial country, possessed of such an extensive sea coast as the United States, not only in continual intercourse with each other, but with the whole commercial world; and certainly nothing can be more important than the means of facilitating that intercourse, and promoting the comfort and safety of those engaged in carrying it on. The marine telegraph flags (so called) are six in number, and correspond to the six positions of the semaphoric telegraph for operations on land. Their use rests upon the same principle, denoting the numerals, 1, 2, 3, 4, 5, 6. They are each *blue* and *white*, and of the same size, with duplicate numbers of each flag. To these is added a *conversation* flag, which, like the *indicator* of the semaphoric telegraph, shows that the vessel making the signal wishes to converse; many thousand changes and combinations can be made, designating the words, phrases and sentences, contained in the telegraph dictionaries. By these means, ships at sea can communi-

cate with each other at the distance of several miles, and when they approach to the coast, can hold communication with the semaphoric land telegraph.*

It is well known that the British government have established lines of telegraph from the Admiralty, near the house guards in London, reaching to several out posts on the sea coast, upon the semaphoric system, and adapted to the numerical principle of operation. Another commercial line of semaphoric telegraph communication is also established from the port of Liverpool to Holyhead in Anglesey, extending along the Welsh coast, under the direction of the trustees of the Liverpool Docks. To this very necessary and useful concern, is attached numerical flags, denominated the Holyhead flag system, adopted by a very large portion of British vessels sailing from that port. This Holyhead system embraces the nine numerals and cypher; its alphabet is divided by nine classes, and never exceeds those figures in making a communication; and furnishes vessels' designating flags of three numerals only, commencing at the unit 1 and progressing to 999.

It must be apparent to every one, that this invention is of incalculable value in case of war, when rapid communication of intelligence may be of vital importance to the whole population of a town, a city, or even the country at large; in ordinary times of peace, and in the usual course of commercial business, when we consider its utility, in the preservation of property, and above all, the lives of our seafaring brethren, we cannot sufficiently appreciate the great value of this invention.

The application of the art to other subjects, will naturally follow the progress of those rapid improvements which are the characteristics of the present age. If we

* See note D.

look at the state of commercial affairs in general, we must be aware what a change has taken place in the transmission of intelligence relating to business, within a few years past, and it would seem too, as if every new impulse, rendered it necessary to add new energy to our means of communication. May we not expect that the demands of business may soon lead to the establishment of telegraphic communications between our principal cities? It cannot be deemed too presumptuous to predict such an event, when we witness the extraordinary resources of this growing country, when we observe the wonderful results of an intelligent and active population, incessantly occupied in developing their powers and resources, and stimulated by the circumstances in which they are placed, to greater and more intense exertion, than the same number of people have probably ever been; when we see too, that all ordinary calculations, founded upon the precedents of other nations, fall short of what is here accomplished;—when we witness all this, we cannot believe that it is being too sanguine, to expect the application of the telegraph to a vastly greater extent than we have yet seen.

How is it, that even the rapidity of the public mail is not sufficient to satisfy the demands of a business community, and we therefore see the editors of newspapers, at an enormous expense, establishing private expresses to convey intelligence from the seat of government to our principal cities? It is because the measures of the government are of vital consequence to the business as well as the political rights of the citizens. We therefore cannot believe, that it is being to sanguine to expect the early establishment of a permanent line of telegraphs throughout the Union.

NOTES.

NOTE A.

Instances have been known of the transmission of important intelligence at the rate of one hundred and forty-four miles in a minute—more than eleven times the speed of sound, and seven times faster than a cannon ball. Not twelve years since, the French papers stated that three thousand messages could be conveyed from Paris, in one day, to any extremity of France, and that answers could be received to them.

NOTE B.

It is both curious and instructive, to see the reflections of Polybius upon the imperfect plans adopted in the earlier ages, and the high state of perfection to which he considered his system to have been brought. He makes the comparison in the same language that we should use in contrasting the improvements of the present day with those of his, and that posterity will perhaps apply to ours. "In former times," says he, "the manner of communicating was too simple, and the invention, upon that account, lost many of its advantages." Œneas, who composed a work on the art of war, perceiving the defects of this method, added some little improvement to this invention, but was very far from carrying it to that degree of perfection which the thing requires.

Œneas's mode of telegraphing was by writing sentences on boards fixed perpendicularly in a circular piece of cork, which nearly fitted the mouth of a vessel full of water, and furnished with a stop cock. On raising a torch at the first station it was acknowledged at the second. On showing a second torch, both stop cocks were turned simultaneously at both stations. When the sentence meant had descended to

the edge of the vessel, by the flow of the water, a torch raised was a signal for turning the cocks, by which ingenious contrivance, the person at the second station found the *same sentence* level with the orifice of the vessel.

Polybius says, "The last method which I shall mention was invented either by Cloxenus or Democlitus, but perfected by myself. This method is precise, and capable of signifying everything that happens, with the greatest accuracy. A very exact attention, however, is required in using it. It is this which follows:

"Take the twenty-four letters of the alphabet, in order, and divide it into five parts, with five letters in each. In the last part, indeed, one letter will be wanting; but this is of no importance. Then let those who are to give and receive the signals write upon five tablets the five portions of the letters, in their proper order, and concert together the following plan: —That he, on one side, who is to make the signal, shall first raise two lighted torches, and hold them erect, till they are answered by torches from the other side. This only serves to show that they are on both sides ready and prepared. That afterwards, he again who gives the signal shall raise first some torches upon the left hand, in order to make known to those on the other side, which of the tablets is to be inspected. If the first, for example, a single torch; if the second, two; and so of the rest. That then he shall raise other torches upon the right, to mark in the same manner, to those who receive the signal, which of the letters upon the tablet is to be observed and written. When they have thus regulated their plan, and taken their respective posts, it will be necessary first to have a dioptrical instrument, framed with two holes or tubes, one for discerning the right, and the other the left hand of the person who is to raise the torches on the opposite side. The tablets must be placed erect, and in their proper order near the instrument. And upon the right and left, there should be also a solid fence of about ten feet in length, and of the height of a man; that the torches, being raised along the top of these ramparts, may give a more certain light, and when they are dropped again, that they may

also be concealed behind them. When all things are thus prepared, if it be intended, for example, to convey this notice—"that some of the soldiers, about one hundred in number, are gone over to the enemy"—it will be necessary in the first place to choose words for this purpose which contain the fewest letters. Thus if it be said, "Cretans a hunded have deserted," the same thing is expressed in less than half of the letters which compose the former sentence. These words, then, being first written down, are communicated by the means of torches in the following manner:—The first letter is Cappa, (C,) which stands in the second division of the alphabet, and upon the second tablet. The person therefore who makes the signal first holds up two torches upon the left, to signify that it is the second tablet which is to be inspected; and afterwards five upon the right, to show that Cappa is the letter which he who receives the signals must observe and write; for Cappa stands the fifth in the second division of the letters. Then again he holds up four torches upon the left, because Rho, (R,) is found in the fourth division; and two upon the right, to denote that it stands the second in that division. From hence, the person who receives the signal writes Rho, (R,) upon his tablet; and in the same manner all the rest of the letters.

"By this method, an account of everything that happens may be conveyed with the most perfect accuracy. It is true, indeed, that because every letter requires a double signal, a great number of torches must be employed. If the necessary pains however be used, the thing will be found to be very practicable. In both these methods, it is principally requisite that the persons employed should first be exercised by practice, that, when a real occasion happens, the signals may be made and answered without any mistake."

NOTE C.

The Semaphoric Telegraph used in Boston Harbor consists of an upright post, having a small movable arm at the upper

end, called the indicator, and two larger arms at convenient distances below the indicator. The indicator (which is used by itself, for the single purpose of referring to the classes of the alphabet in the Dictionary) and the arms, may be placed each in six different positions. These several positions denote the numerals from one to six, so that the two arms together can take twice six, or twelve positions; and this number, by the familiar principle of permutation, affords sufficient changes to express any numeral from one to hundreds of thousands upon the numerical plan.

With the semaphoric telegraph are used three books like dictionaries, containing sets of numerals placed in order, with the words denoted by them standing against them, exactly upon the principle of a dictionary of any language. The telegraphic dictionary only differs from any other in having a series of numerals, instead of a series of words, under each letter of the alphabet, with the meanings of the number affixed to them; just as in a French dictionary, for example, the French word would be put first, and then the English meaning by its side. Now the arms of the telegraph, being placed in certain positions, denote particular numbers. The observer, then, upon seeing the positions of the arms, looks into his telegraphic dictionary for the number denoted by the indicator, referring to the class or letter of the alphabet under which the communication may be found; and afterwards, by the side of the number denoted by the arms, he finds the word signified by it. This is a general view of the principle of the invention. The numerical dictionary embraces, so far as can be anticipated by experience, all the questions and answers which are likely to occur between vessels at sea, or at the telegraph stations along the coasts. It contains also a list of numerals, designating the names of nearly two thousand vessels which have adopted the semaphoric numerical system, together with the names of all the principal countries, ports, towns, cities, rivers, headlands and harbors.

NOTE D.

The arrangement of the marine telegraph flags is shown at the beginning of this tract.

To exemplify more fully the great utility of the Flags or Marine Telegraph, I am happy to add the following communication from an intelligent navigator and merchant of this port, Bryant P. Tilden, Esq., whose authority as a practical man gives the greatest weight to his statements and opinions:

"The first time (by way of illustration) I experienced the advantage of flag conversation was in the year 1815. We saw five big ships spread in line, by *signal* orders, to prevent our passing them. Having proper documents to inform of peace, we ran up our colors and stood for the centre ship. The boarding officer on being satisfied, said—'Run up your ensign in the fore rigging; that is our signal agreed upon to inform the squadron, that *peace between our nations has been made;* and it will save you the trouble of being overhauled and detention.'

"After informing the officer of Bonaparte's escape from the island of Elba, he directed us to hoist the ensign in the main rigging, saying, 'That is a signal *to inform of news.*' The seventy-four, and four frigates, were at the time sailing in a lazy cruising manner, but immediately on seeing our last signal, the Admiral began conversation with the fleet; and, as if by magic, up went top gallant mast yards and booms, and in twenty minutes they were under a crowd of canvas. The officer seeing the signals from the Admiral, said, '*That is for me to go on board, and for all hands to get to Old England as soon as we can.*' Without these *talking* flags it would have taken hours to have communicated three such important points by means of boats or otherwise.

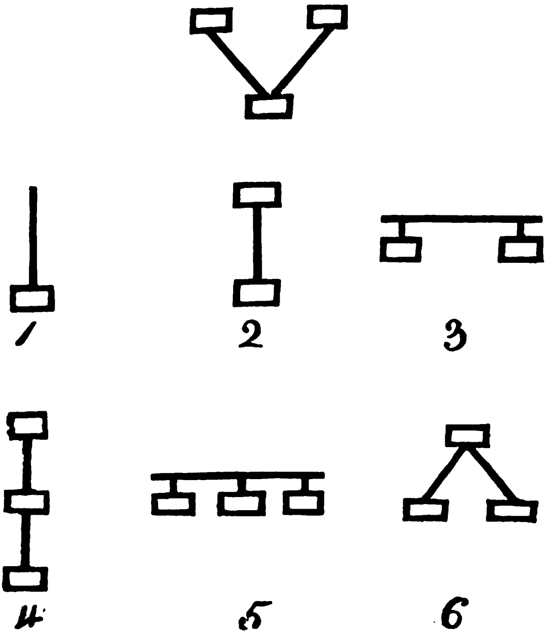
"One more instance happened a year before the last, when I was going in company with several English captains from Macao to Whampoa in an English schooner packet. When in sight of the shipping, tide turned down river, and it being calm, we came to anchor. Fortunately the packet had con-

versation flags, and on signal being made, down came four boats to take us up to Canton, where otherwise we should not have reached until the next tide.

"Sometimes a boat cannot live upon the sea, and it may blow a gale, which prevents speaking. Our *Conversation Flags*, in such cases, obviate all difficulties."

SEMAPHORIC SIGNAL LIGHTS,

FOR NOCTURNAL COMMUNICATION.



[redacted]

COMBUSTION.

BY R. A. COFFIN.

Queries suggested. Former views on the subject.

The fact that fire will not burn without the presence of air, is universally known. Perhaps in many minds, while contemplating this fact, such inquiries as the following have arisen:—What is the reason that the presence of air is necessary?—How does the air act on the fire to make it burn?—Does the fire produce any effect on the air which comes in contact with it? and if so, what effect?—What is flame?—how is it produced? and what becomes of it, when extinguished? In many instances, probably, the inquirer has found himself unable to obtain any satisfactory answer to his questions. But it is by inquiries like these that truth is discovered.

For a long period, the views which prevailed among philosophers, in regard to the nature of that operation which we call combustion, as well as to the laws by which it is regulated, were very erroneous. The name of *phlogiston* was given to the agent by which the process of combustion was supposed to be effected. Hence this theory is often called the phlogistic theory. Every combustible body, said the advocates of this theory, contains a quantity of phlogiston. Some bodies are more combustible than others, because they contain more phlogiston, or give it out more readily. Some bodies contain no phlogiston, and are therefore wholly incombustible. When a

body burns, it gives out phlogiston. The light and heat are occasioned by the violent agitation of the phlogiston, at the moment of its escape from the burning body. The reason why a body which has been burnt once cannot be burnt again is, that it has lost all its phlogiston.—Such was the theory which philosophers taught, and in which their hearers for a long time acquiesced. Without examination—without experiments—the existence of phlogiston was assumed, and on this assumption, a theory was framed, by which it was supposed that all the phenomena of combustion could be explained. No one could tell what were the properties of this powerful agent, for no one had ever obtained it, or even seen it. Still, however, its existence and influence were spoken of with as much confidence as if it were equally well known with air or water.

The discovery of oxygen by Dr. Priestly, in 1774, prepared the way for the overthrow of the phlogistic theory; and the experiments of Lavoisier, made not long after, proved that burning bodies, instead of giving out phlogiston, absorb oxygen. In order to a clear understanding of the philosophy of combustion, it is necessary to know the leading properties and characteristics of oxygen; and these, therefore, will now be stated.

Oxygen is a colorless, tasteless and inodorous gas. It is perfectly invisible when in a state of gas—and this is the only state in which it has ever been obtained pure. It is a little heavier than atmospheric air, about in the proportion of $1\frac{1}{8}$ to 1. It forms about one fifth of the atmosphere, and eight ninths of water; and enters more or less into the composition of nearly all vegetable and animal substances. Many minerals contain it in large quantities. In short, no other material substance is so extensively diffused as oxygen. The most striking prop-

erty of this remarkable substance is its power of exciting and supporting combustion. A candle or wax taper, freshly extinguished, is relighted on being immersed in a bottle of this gas. A watch spring, or piece of iron wire, will burn as readily in oxygen as paper will in common air. All that is necessary to exhibit this phenomenon is, to affix a piece of tinder to the watch spring or the wire, light it, and immerse it in the gas. The metal will immediately take fire, and burn with a most beautiful and brilliant light. Oxygen is never found in nature in its pure, uncombined state. In many cases, however, it is not difficult to separate it from the substances with which it is combined, and thus to obtain it in sufficient quantity, and of requisite purity, for performing various interesting experiments. The substances from which it is most generally obtained are oxyde of manganese, chlorate of potash, red lead and nitre. By strongly heating these, the gas will be given off.

As the terms combustible and supporter of combustion will frequently be used in the following pages, it may be well briefly to state the meaning of these terms, and the theory which gave rise to the use of them. Substances which will burn are called combustible ; those which will not burn, themselves, but *in* which other substances will burn, are called supporters of combustion. Thus hydrogen gas is called a combustible, but not a supporter of combustion ; because it will burn itself, but other substances will not burn in it. Immerse a candle in this gas, and it will be extinguished, while, at the same time, it will set fire to the gas. It was formerly supposed that the properties of a combustible body, and those of a supporter of combustion, were so utterly incompatible with each other, that they could not exist together in the same body. This supposition is now known to be

incorrect, as there are some substances which will both burn themselves and allow others to burn in them. It is not, therefore, strictly proper to regard combustibles and supporters of combustion as two distinct classes of bodies. Still, however, this classification is often made, and as these terms are frequently found to be convenient, they may perhaps be used without injury, except in cases in which great accuracy is required. In accordance with these views, and with sufficient accuracy for our present purpose, combustion may be defined, the combination of a supporter of combustion with a combustible body, attended with the disengagement of light and heat.

For a long time after the discovery of oxygen, it was supposed to be the only supporter of combustion in existence. The researches of modern chemists have, however, brought to light several other substances which appear to possess the same property; though it is supposed by some that these substances contain oxygen, and that to this they owe their power of supporting combustion. However this may be, they are of little importance, in comparison with oxygen; and in a sketch like this, it is perhaps sufficient merely to give their names. These are chlorine, iodine, fluorine and bromine. One or two others may possibly deserve to be reckoned in the list, but their claim is at least questionable. In fact, *all* common cases of combustion are produced by the union of oxygen with a combustible substance. If a candle be covered with a tumbler, or anything else, in such a manner as to prevent the access of air, it will burn for a short time, and then go out; and the time that it continues to burn will be found to depend on the quantity of air enclosed with it. Some substances have so strong a tendency to combine with oxygen, that when made to burn in a confined portion of air, they will continue to

burn till there is scarcely a particle of oxygen left. Such is the case with phosphorus. Other substances have various degrees of affinity for oxygen. A candle, enclosed as above mentioned, is extinguished while yet a considerable portion of the oxygen remains unconsumed—thus showing that its affinity for oxygen is considerably less than that of phosphorus. Some of the metals have so little affinity for oxygen, that it is extremely difficult to burn them. Such is the case with gold and platinum. No metal, however, is absolutely incombustible. *The combustibility of a body in common air is in proportion to its affinity for oxygen.*

Though the nitrogen of the atmosphere does not aid in producing combustion, it is nevertheless highly useful. If the atmosphere were pure oxygen, our stoves would burn together with the fuel put into them; our culinary vessels would take fire almost as readily as tinder does now; and a building on fire would burn with a violence and a rapidity which would render the idea of extinguishing it preposterous. The Creator has wisely combined the oxygen and nitrogen of the atmosphere in such proportions that, while the power of supporting combustion is still amply sufficient for all the common purposes of life, the fearful consequences are prevented which would result from the unrestrained action of pure oxygen.

In regard to the heat and light produced by combustion, various opinions have been entertained. Indeed, the question how combustion produces light and heat is not now fully settled. It is not strange that this question should attract the attention of inquiring minds. A few sparks of fire, scarcely sufficient to produce any perceptible heat, are communicated to a mass of combustible matter: portion after portion of the mass kindles, and soon the whole of it is in a state of vivid inflammation,

sending forth light and heat in abundance. Whence do this light and heat originate? Were they contained in the air, or the combustible; or in both; or in neither? If contained in either, why did we not see the light and feel the heat before? If not contained in either before, how came they to be here now? We know too little of heat to give very definite answers to these questions.

Lavoisier, a celebrated French chemist, endeavored to explain the evolution of heat during combustion on what is called the doctrine of *latent heat*. It is well known that bodies, in passing from a solid to a liquid, or from a liquid to an aeriform state, absorb heat. Thus ice absorbs heat in turning into water; and water does the same in turning into steam. If we place a quantity of cold water over a fire in one vessel, and an equal quantity of ice over a similar fire in another vessel, the water will become almost boiling hot before the ice is all melted, while the water formed from the ice will not appear to have increased in warmth at all. Now as both were equally exposed to the action of the fire, it appears that the heat which entered into the ice exists in a latent or imperceptible state in the water produced by the melting of that ice. It is therefore called latent heat. Again, if a quantity of water, as cold as it can be without freezing, be placed over a fire and made to boil, and then kept boiling till it has all passed off in vapor, it will be found, if the heat has been applied uniformly, that the time occupied in making the water boil is but about one fourth as long as that occupied in boiling it away—thus showing that much more heat exists in steam than in boiling water. But the steam will afford no indications of this greater quantity of heat. As bodies, in passing from a solid to a liquid, and from a liquid to a gaseous state, absorb heat, so when the opposite changes take place, the action of

the body on heat is reversed. If we place a thermometer in a vessel of water, and let it remain there till the water freezes, the mercury, when the water begins to freeze, will rise several degrees—thus showing that the water, in passing from a liquid to a solid state, gives out heat. A striking exhibition of the same principle is found in the slaking of lime. If water be combined with lime, in any proportion not exceeding nine parts of water to twenty-eight of lime, the mixture will remain dry, showing that the water is no longer in a liquid state. A great degree of heat will also be produced, resulting from this change in the state of the water. In fact, bodies, in passing from a liquid to a solid state, give out just as much heat as they absorb in passing from a solid to a liquid state. And in passing from an aeriform to a liquid state, they give out just as much heat as they absorb in passing from a liquid to an aeriform state. A melted metal, in becoming hard, gives out as much heat as it took to melt it. Water, in becoming ice, gives out as much heat as ice absorbs in becoming water. And steam, in becoming water, gives out as much heat as water absorbs in becoming steam.

From the doctrine of latent heat, which has thus been illustrated at some length, many chemists endeavor to explain the heat produced by combustion. The oxygen of the atmosphere, say they, unites with the burning body, and in so doing, passes from a gaseous to a solid state; and consequently, gives out the heat which previously existed in it in a latent state. But there are various circumstances which show that this explanation is not, in all cases, admissible. In the explosion of gunpowder, for instance, the oxygen which combines with the powder is not changed from a gas to a liquid or a solid, but, on the contrary, the powder is changed from a

solid into gases; and yet a very considerable degree of heat is produced by the explosion of gunpowder. The fact that bodies may be inflamed by friction furnishes another objection to the theory under consideration. It is well known that by powerful and long continued friction, many bodies may be set on fire. In those cases in which oxygen is present, it may be said, and probably with truth, that the oxygen combines with the substances rubbed, and thus produces combustion. But there is heat produced before this combination commences. And not only so, but in a vacuum, where there is, of course, no air of any kind, friction produces heat.

Berzelius, a celebrated Swedish chemist, supposes that heat is in all cases the result of electrical action. It is generally the case that bodies which combine chemically with each other, are in opposite electrical states, one of them being endued with positive, and the other with negative electricity. Heat, therefore, says Berzelius, results from the union of the two electricities. This is an interesting theory, but its correctness remains to be proved. There are difficulties relating to the subject which it does not remove. At present, it must be regarded rather as an ingenious and plausible theory than as a well established principle.

But whatever views may be taken of the manner in which the union of a combustible body with a supporter of combustion produces heat, the fact that heat is produced by such a union is unquestionable. The degree of heat appears to depend partly on the combustible, and partly on the supporter of combustion. Thus in burning iron, the combination of that metal with a given quantity of oxygen, produces more heat than the combination of charcoal with an equal quantity of oxygen. The heat produced is, however, in most instances, so nearly pro-

portioned to the quantity of oxygen consumed, as to show that it is derived in a great measure from that substance.

A knowledge of the relation existing between the air and combustible bodies, will enable us to explain many interesting phenomena of combustion, and many facts, well known, but not generally understood, which relate, more or less directly, to that process. It is a well known fact that fire will keep much longer when buried in ashes than when exposed to he action of the air. This results from two causes. First, the free access of oxygen is prevented, so that the fuel is not so rapidly consumed; and secondly, the power of ashes to conduct heat not being great, the heat passes away much less rapidly than it does when radiated freely into the air. If fire were covered with a substance which is a good conductor of heat, it would soon be extinguished ; and on uncovering it, we should find a collection of black coals. If covered with anything which would not diminish the supply of oxygen, it would soon burn out, and we should find nothing but ashes remaining. It is worthy of remark, that wood, in burning, produces a substance possessing both the properties which we have thus shown to be necessary to preserve fire.

The action of a bellows on a wood fire makes it burn better; but the same action on a fire of anthracite coal tends to extinguish it. At the same time, as is well known, a strong, steady current of air is indispensable in the burning of anthracite coal. This coal is composed principally of carbon, and so is the coal from a wood fire ; but the greater solidity of anthracite coal renders it much more difficult for oxygen to combine with it than with common coal. So much more difficult is it, that it is necessary for the air to be strongly heated, in order that its oxygen may combine with the coal. The current of

air produced by the draught of a grate passes through the whole body of coal, from the bottom to the top; for it is produced by the pressure of the more dense air, to supply the place of the heated and rarefied air above the grate. The air which thus presses in becomes, in its passage through the coal, sufficiently heated for its oxygen to combine with the coal, and produce combustion. The current of air produced by a bellows, on the contrary, has little or no tendency to ascend, and ceases nearly as soon as it is beyond the reach of the action of the bellows. It is comparatively cold; it acts principally on the external surface of the mass, instead of penetrating into the interior; and this external surface being most exposed to lose its heat by radiation, is the very part which is the most difficult to kindle, and the most easily extinguished. These circumstances seem to be sufficient to account for the difference between the effects produced by a bellows and those produced by a steady current of air. The difference between the brightness of the upper surface and that of the front surface of a body of anthracite coal, when burning in a grate, is too striking not to be noticed. The upper surface is acted on by a current of air which has become heated by passing through the coal below, while the front surface is acted on by cold air from the room. The blower of a grate, when up, compels nearly all the air which has access to the coal to pass through the whole mass, and thus it makes the coal burn brighter and more rapidly.

A fire of anthracite coal is commonly extinguished long before the fuel is all expended. The reason, says Dr. Arnott, is that the fire, left to itself, does not produce heat enough to maintain the inflaming temperature of the substance. By keeping the coal in as compact a form as possible, it may be more nearly consumed than it would

otherwise be ; for then a portion of the heat radiated by each piece goes to keep up the temperature of the other pieces. Charcoal, similarly situated, will often burn entirely out, because it does not require so great an elevation of temperature to make it burn.

It is a common remark that the more we stir a fire of anthracite, the less it seems inclined to burn. By stirring it, we expose more or less of the strongly heated ortions to currents of cold air, and thus cause them to lose their heat, while, by bringing portions which are not strongly heated in contact with those that are, a great part of the heat radiated by the latter is absorbed by the former.

There are but few substances which have so strong an affinity for oxygen as to combine with it at the common temperature of the air, with sufficient energy to produce combustion. Phosphorus, in warm weather, will take fire without artificial heat; and there are some few other substances equally combustible with phosphorus, and a few even more so. In most of the cases of spontaneous combustion which occur, a gradual change in the chemical structure of the substances goes on for some time before the combustion takes place ; and by this change, an elevation of temperature is produced sufficient to set the substances on fire. Such is the case in the spontaneous combustions by which factories have been repeatedly endangered. In the same way barns have sometimes been set on fire, by the heat resulting from the partial decomposition of newly mown hay. A striking exhibition of this principle is mentioned by Dr. Richardson, who accompanied Franklin the navigator, in his expedition to the Arctic Ocean. The shale on the coast, containing sulphur, and resting on masses of coal, had, in many places, taken fire, by the action of the atmosphere on the sulphur.

FUEL.

Though there are very many combustible substances in existence, yet those which are generally used for the artificial production of heat, are almost universally composed principally of two substances, termed in chemistry, carbon and hydrogen. With these oxygen, sulphur, and some other substances are occasionally combined, but generally in small quantities, excepting in wood, some kinds of which contain nearly as much oxygen as carbon. Anthracite coal sometimes contains 95 per cent of carbon. It sometimes contains a little sulphur, which causes it to give off a very unpleasant gas (sulphurous acid) when burning. The quantity of flame produced by the burning of different kinds of fuel, is nearly in proportion to the quantity of hydrogen contained in them. Charcoal burns with but little flame, because nearly all the hydrogen is consumed during the process by which the charcoal is obtained. If there were no hydrogen in the charcoal, there would be no flame, for pure carbon burns without flame. The care of the Creator for his creatures is strikingly exhibited in the fact, that of all the combustible substances known, carbon and hydrogen, the most convenient for man's use, are also the most abundant; and procured with the greatest ease. Besides coal and wood, which have been already mentioned, oil, tallow, wax, &c., are composed principally of carbon and hydrogen. The gas so extensively used in lighting streets is composed exclusively of these two substances, and is hence called carburetted hydrogen. Of the other combustible substances known, some give but very little heat, some burn with great violence and last but a very short time, some explode on being inflamed, and all, or nearly all, are deficient in some of the properties necessary to accomplish

the various purposes for which fuel is used. But all the compounds of carbon and hydrogen give out considerable heat, and all of them (with the exception of carburetted hydrogen) burn quietly and steadily, and last a considerable length of time. And even carburetted hydrogen, though naturally explosive, can be made, by the art of man, to burn as regularly and quietly as a candle.

To supply the vast demand which there must necessarily be for fuel, not only is a large part of the earth's surface covered with wood, but vast quantities of coal are stored in mines below the surface. The coal mines of Britain, it is said, contain coal enough to last one thousand years at the present rate of consumption. And yet coal is now very extensively used in that country. There are, it is well known, extensive and valuable coal mines in various parts of the United States. In Pennsylvania they abound. The following remarks respecting the Pennsylvania coal are from the Gazetteer of the United States, published in 1833:—"The strata actually known are vast, and beyond the power of man to exhaust in many succeeding ages. The coal beds are of every variety of thickness, from less than six inches to immense mountain masses of unknown extent. The largest body of anthracite yet laid open, is that explored and worked on Mauch Chunk mountain, by the Lehigh Coal and Navigation Company. It is probable, however, from numerous indications, that the most extensive deposits of coal east of the mountains remain unexplored, perhaps undiscovered. In the vicinity of Pittsburg the coal strata are in extent immense, in thickness from three to six feet. In every part of the adjacent country where sufficient pains have been taken, coal has been found; and from analogy, we may suspect its existence as underlaying strata far into the state of Ohio."

The following table exhibits the degree of heat given out by the several kinds of fuel mentioned, according to the most accurate experiments that have been tried in relation to the subject. The first column contains the names of the substances on which the experiments were tried, and the second the quantity of ice, which the heat given out by one pound of those substances in burning would melt.

ONE POUND OF	MELTS OF ICE,
Good mineral coal,	90 lbs.
Charcoal,	95
Wood,	32
Peat,	19

The quantity of ice melted may perhaps seem surprising to some, but it is to be borne in mind that all the heat given out by the burning substance, in every direction, was made, as far as possible, to act on the ice.

The following table shows that a relation, though not an exact one, exists between the amount of heat given out and the quantity of oxygen absorbed by different substances while burning.

ONE POUND OF	MELTS OF ICE,	TAKES OF OXYGEN,
Hydrogen,	370 lbs.	7½
Carburetted hydrogen,	85	4
Olive Oil,	120	3
Wax,	110	3
Tallow,	105	3
Charcoal,	95	2⅔
Phosphorus,	100	1½
Sulphur,	25	1

As different kinds of wood differ in the proportions of carbon and hydrogen which they contain, and consequently in the quantity of oxygen which they absorb in

burning, we may conclude that there is some difference in the amount of heat given out by them. Probably, however, this difference, should we try equal weights of different kinds of wood, would be found less than we are apt to suppose. A stick of walnut will give out more heat than one of hemlock of the same size, because there is actually more wood in the former than in the latter. But take equal weights of each, and the difference in the amount of heat given out will probably not be great. It seems reasonable to suppose, that if we take equal weights of different kinds of wood, the most heat will be given out by those kinds in which the carbon and hydrogen bear the greatest proportion to the oxygen, because the heat results from the combination of the two former substances with the oxygen of the atmosphere. And if we should take two kinds of wood containing equal quantities of oxygen, we should probably find that the most heat would be obtained from that which contained the greatest proportion of hydrogen, because hydrogen gives out more heat in burning than carbon. Such would undoubtedly be the case, if all the hydrogen were burnt. And although in many cases some of the hydrogen escapes with the smoke, thus causing a diminution in the amount of heat produced, this does not probably take place to such an extent as to affect the general principle. These views are, to a considerable extent, confirmed by experiment. Oil, for instance, contains more hydrogen and less oxygen than wood; and a pound of oil gives out much more heat than a pound of any kind of wood.

It is often said that green wood, though it does not burn so quick as dry wood, makes ultimately a hotter fire. This may perhaps be true. Some kinds of green wood contain half their weight or more of water. While this water is evaporating, much heat passes off with the vapor,

and of course so much the less is left to keep the wood burning. But when the wood has become well kindled, some of the water is probably decomposed into its elements, hydrogen and oxygen, and the burning of the hydrogen thus set free must produce more or less heat in addition to that produced by the wood. Whether the heat derived from this source is sufficient to compensate for all that is lost by evaporation, is at least questionable.

Flame.

Newton supposed flame to be ignited smoke or vapor. His supposition was not very erroneous, neither was it perfectly correct. When a body is volatilized, or, in other words, when it assumes the form of gas or vapor before it burns, its combustion generally produces flame. Some combustible substances naturally exist in an aeriform state. These almost invariably burn with flame. They are sometimes solidified by being combined with other substances; but even then, on applying heat, they separate, and assume their natural gaseous form, before they take fire. The heat produced by the burning of some solid substances is sufficient to volatilize them. When this is the case, the burning of those substances produces flame. Phosphorus furnishes an instance of this. This substance naturally exists in a solid state, requiring a temperature of 108° of Fahrenheit's thermometer to melt it. But the heat produced by its combustion is sufficient not only to melt but to volatilize it. The brilliant flame of phosphorus consists, therefore, of that substance in an aeriform state, combining with the oxygen of the atmosphere. There are some metals which may be first volatilized by heat, and then made to burn with flame.

The flame of organized bodies generally consists of a compound of carbon and hydrogen, termed carburetted hydrogen. This gas may easily be obtained in its separate state from almost any vegetable substance. Put a few pieces of wood or bark into a gun-barrel, and heat them strongly, and the gas will come off, and may be collected by letting it pass up through water into a tumbler. Or place them in a vessel of any kind that will bear strong heat without injury, cover them with sand, and then heat the vessel red hot, and the gas will come up through the sand, and, on applying the flame of a candle, will take fire. All kinds of wood, when burning, give off this gas in large quantities. It is sometimes the case that when dry wood is placed over a collection of hot coals, it will smoke for a considerable time before it begins to blaze, and at length will burst into flame with a slight explosion. This explosion is caused by the sudden combination of the carburetted hydrogen given off by the wood, with the oxygen of the atmosphere. It is worthy of remark that though this gas, when inflamed in large quantities, is powerfully explosive, as the disastrous explosions produced by it in coal mines show, yet in the combustion of the substances commonly used for fuel, it is liberated so gradually that the combustion of it is unattended with danger.

Two interesting characteristics of flame are, its tendency to ascend, and its almost regular decrease in size, causing it finally to terminate in a point. The former of these is explained by the fact, that the combustible gases, and the substances which they produce in burning, are, in some cases, of themselves lighter than the air, and in others, are rendered lighter by the rarefying power of heat. They, of course, tend to rise in that fluid. The latter may be explained thus:—As the combustible gases

will not burn, unless united with a supporter of combustion, and as no supporter of combustion except oxygen exists in the atmosphere, it follows that these gases will not produce flame any farther than oxygen combines with them. As the gas rises from the burning body, its external surface, coming into contact with a portion of oxygen, unites with it, and thus burns. The inner portion rises, and unites with another portion of oxygen a little higher up, and burns in the same way. And thus the process continues till the central part of the current of gas meets with oxygen, and takes fire, when the flame terminates, in consequence of the combustible matter being consumed.

It is observable that, in a candle, there is usually a small space between the flame and the substance of the candle. A large part of the heat produced by the lower part of the flame being employed in melting the solid matter of the candle, in order to prepare it for decomposition, there is not heat enough left to produce combustion, in the immediate vicinity of the unmelted matter. This shows us why candles with very short wicks are so easily extinguished. In lamps, the combustible matter being already fluid, the flame extends down very near to the top of the tube which contains the wick. The reason why, in some cases, it does not extend *quite* down, probably is, that the heat is carried away too rapidly by the metallic tube, this being a good conductor of heat.

There are a few cases in which a volatilized body may be made to burn without flame. When a coil of platinum wire is heated to redness, and suspended above the surface of ether contained in an open vessel, the wire instantly grows hotter, and continues at a glowing red heat till all the ether is consumed. In this case, although the metal becomes intensely ignited, and the smell of burning ether is distinctly perceptible, the vapor rising from the

ether does not appear luminous in the least degree. A similar effect is produced on platinum by the action of hydrogen gas. The reason why other metals are not acted on in the same manner as platinum, appears to be, that they are better conductors of heat, so that the heat passes off from them faster than this slow combustion can supply it. From these facts, and others well known to chemists, it appears that more heat is necessary to render gases and vapor red hot than to produce the same effect on solid substances. Hence we see why it is so difficult to make many substances burn with flame, unless we apply flame to them. By applying a live coal to the wick of a candle, we can easily make it burn a little, but it will not generally blaze, unless we blow the coal. The heat of the coal is, of itself, sufficient to make the wick sparkle, and smoke, and give off some gas, but is not sufficient to raise that gas to a red heat, or to make it combine with the oxygen of the atmosphere; but the heat produced by flame is sufficient to do both these. By blowing the coal, its temperature is raised, in consequence of the increased supply of oxygen with which it is furnished, and this produces a more rapid disengagement of the hydrogen contained in the interior part of the coal, and this hydrogen, as it is evolved, takes fire itself, and lights the candle applied to it.

There is a very great difference in the brightness of the flame produced by different substances, and a very marked disproportion between the amount of light and heat which they emit. Hydrogen burns with a very pale flame, and phosphorus with a very brilliant one; and yet the heat produced by the combustion of hydrogen is, as has been stated, much greater than that produced by the combustion of phosphorus. The brightness is, in some measure, proportioned to the density of the gas or vapor

by which the flame is produced. The light of a lamp results, in part, from particles of intensely ignited charcoal, carried up by the current of gas which rises from the wick. The actual existence of this charcoal is manifest, from the fact that a wire held in the flame of a lamp, almost instantly becomes covered with particles of charcoal adhering to it. The quantity of light emitted is considerably affected by the velocity with which the volatilized matter ascends. If the velocity be too great, the current will be too much cooled by coming into contact with so much air. If too small, it will not have access to air enough to keep it burning.

Tallow, oil, and similar substances require a temperature of about 600° Fahrenheit to make them burn. The wick of a candle or lamp draws the melted combustible matter, by capillary attraction, up to the point at which the combustion commences; and there, the requisite degree of heat being supplied, it begins to burn. The aid of the wick is indispensable, also, in commencing the combustion by which the decomposition of the substance to be burned is effected.

The cheapest substance now known, for the purpose of giving light, is doubtless carburetted hydrogen—the gas so extensively used in lighting streets, large manufactories, &c. The cost of a lamp fed by this gas, and giving the light of seven candles, is stated to be three farthings per hour, while that of the same amount of light obtained from spermaceti oil is stated at three pence per hour, from mould candles at three and a half pence per hour, and from wax candles at fourteen pence per hour. The cost, however, of the apparatus, and the amount of labor necessary in preparing this gas, are so great that it cannot be used to advantage, unless a large number of lights are wanted. Carburetted hydrogen was formerly obtained

almost exclusively from coal; but it has recently been discovered that it can be obtained of better quality, and at less expense, from oil. The very worst of whale oil, that which is hardly fit for anything else, affords an abundance of gas of superior quality. The apparatus necessary consists of a furnace, through which passes a contorted iron tube, with fragments of brick or coke in it. The oil being suffered to drop into this tube, when red hot, is decomposed, and thus the gas is formed.

Products of Combustion.

Those substances which are formed by the burning of other substances are termed the products of combustion. Some substances, in burning, give rise to several different products, others to only one. The only substance produced by the burning of hydrogen is water; by that of diamond, carbonic acid; by that of sulphur, sulphurous acid. Wood, containing both hydrogen and carbon, together with more or less of several other substances, furnishes a variety of products. Some substances, by combustion, furnish solid products, others, liquid, and others still, gaseous. Thus the metals, in burning, produce solid substances, termed in chemistry oxydes; hydrogen produces a liquid, and charcoal and various other substances, gases. The fatal consequences which result from burning charcoal in lodging rooms, &c. are well known. The immediate agent in producing these effects is the carbonic acid gas generated by the combustion of the charcoal. This gas is eminently fatal to animal life. In chemical lectures, its effects are frequently exhibited. A mouse placed in a tumbler filled with it, will at first appear convulsed, and in a minute or less, will cease to move. If he be immediately taken out, he may be re-

stored to life; but if suffered to remain, the vital principle soon becomes wholly extinct. The idea entertained by some, that wood, in burning, does not produce the same gas with charcoal, is wholly erroneous, and should be discarded. The only difference is, that the gas given off from wood is combined with water. This probably diminishes, in some degree, the injurious effect of the gas, but by no means destroys it. The combustion of nearly all organized bodies produces carbonic acid. A hot stove often renders the air around it impure, by decomposing the particles of dust which come into contact with it, and thus producing this gas. One advantage of keeping water on stoves is, that the vapor rising from it combines with the carbonic acid thus generated. Another advantage is, that it tends to keep the air moist, and fit for respiration.

The products of combustion are very generally, though not universally, deleterious. Many of the most virulent mineral poisons are produced by the burning of the metals. Phosphorus, in burning, produces a deadly poison. Sulphurous acid, the suffocating gas that arises from burning sulphur, is perhaps not less fatal than carbonic acid.

Smoke may perhaps seem to be regarded as one of the products of combustion; but it is not strictly so. When some of the volatilized particles by which flame is produced do not undergo complete combustion, they pass off in the form of smoke. Thus when the wick of a lamp is raised too high, so that too much of the oil brought up by it is exposed at once to the action of the flame, the oil is volatilized faster than it can be decomposed; the heat of the lamp being sufficient to decompose, and thus prepare for combustion, only a certain limited quantity. A partial decomposition therefore takes place, by which the more

combustible portion of the oil is burnt, while the rest, consisting mostly of carbon, minutely divided, escapes in the form of smoke. The more smoke there is attending combustion, the greater is the quantity of heat which is lost. For every particle of combustible matter that escapes without being burnt would, if burnt, produce some heat. Smoke was formerly supposed to be lighter than air, because it ascends in that fluid. The fact is, however, that it is somewhat heavier, and that it is made to rise by the current of rarefied air which ascends from the fire. This may be shown by letting smoke rise through cold water, so as to cool it and the air mixed with it. It will then remain on the surface of the water, instead of rising in the air. From smoke an acid is obtained, which is usually called pyroligneous acid. It is however not a simple acid, but a mixture of several different substances. It is composed principally of acetic acid, (the basis of vinegar,) tar, and some volatile oil. It has nearly the same effect on meat that smoke itself has, but acts with more rapidity. The presence of this acid in smoke is one reason why that substance makes the eyes smart when exposed to it.

Explosions.

When the combination or decomposition of substances proceeds with very great rapidity, and gives rise to products differing greatly in bulk from the original substances, such combination or decomposition usually produces an explosion. Thus when gunpowder is inflamed, it is instantly converted into sulphurous acid, carbonic acid, carbonic oxyde and nitrogen, together with some sub-carbonate, sulphate and sulphuret of potash. The first four substances mentioned naturally exist in an aeri-

form state. The others naturally exist in a solid state, but are wholly dissipated by the force of the explosion. The aeriform products of the combustion of gunpowder possess vast expansive power, and therefore require an enormous pressure to prevent them from assuming their natural aeriform state. Thus carbonic acid, at 32° Fahrenheit, exerts pressure of 540 pounds to the square inch. By increasing the warmth, this force is proportionally increased. Dr. Arnott remarks that the exploding particles begin to separate from each other with a velocity as if ten thousand volumes of air had been condensed into one. This serves to explain the force and swiftness with which a bullet is propelled by means of gunpowder. What the cause is which gives to these substances their tendency to separate thus, is yet undetermined. Perhaps the most probable supposition is, that they contain a vast quantity of heat in a latent state, and that this, by its expansive power, drives the particles apart.

Explosions sometimes appear to result from the sudden condensation of elastic fluids. Thus if two parts of hydrogen, by bulk, be mixed with one of oxygen, the mixture, on being inflamed, will explode with a loud report, and water will be formed. It is sometimes stated that the explosion, in this case, is owing to the sudden condensation of the two gases in forming water. But it may be questioned whether any such sudden condensation takes place. Tke intense heat produced by the burning of oxygen with hydrogen, would seem to be sufficient to make the water occupy even a greater space than the gases did before their combination. Perhaps each particle of oxygen, as it unites with a particle of hydrogen, produces a slight sound, and the explosion is the result of a multitude of such combinations occurring simultaneously. The force of an explosion seems to depend, 1.

on the quantity of elastic fluid produced; 2. on the velocity it acquires by a certain degree of heat; and 3. on the celerity with which the heat affects the whole mass of the explosive substance.

The sound produced by explosions probably depends upon the sudden percussion given to the air. The great increase of sound when powder is confined in a gun-barrel, for instance, may be explained by the communication of the percussion to the metal, causing violent vibrations, which are propagated along the tube, and thence to the air.

Extinguishing Fires.

The extinguishing of fires depends on these two principles:—1. By preventing the access of air to a fire, we cut off the supply of oxygen, without which the process cannot go on; 2. by taking away the heat, we reduce the temperature so low that, even if oxygen be present, the combustible matter will not unite with it. Thus, if we cover a flame with woollen cloth, we endeavor to extinguish it by keeping away oxygen; and if we put on water, we endeavor to extinguish it by reducing its temperature. When water is put upon a burning body, a part or the whole of it is volatilized; and as substances in passing from a liquid to an aeriform state, absorb much heat, the temperature is so much reduced that the combustible body will no longer combine with oxygen, and the combustion therefore ceases. In addition to this, the steam which is formed prevents, to a considerable extent, the access of air, and of course tends to diminish the violence of the combustion. Hence the efficiency of water in extinguishing fire. A small quantity of water thrown on a brisk fire may, and sometimes does, increase, instead of extinguishing it. For, as red hot coal has the power

of decomposing water, this decomposition, if the heat is sufficiently great, will furnish hydrogen—a very combustible substance—and thus the fire will have an additional supply of combustible matter. Blacksmiths frequently sprinkle water on their coal, in order to increase the heat. The question whether, in any given case, the heat is increased or diminished, depends on the proportion which the water that is decomposed bears to that which is evaporated. All that is decomposed tends to increase the heat; all that is evaporated, to lessen it. In extinguishing a candle by the breath, we blow away the ignited portion of gas, and the heat of the wick not being sufficient to make the gas burn, or even to keep the wick itself burning, the combustion ceases.

From the tendency both of flame and of heated air to ascend, it follows that bodies burn much more readily when the combustion begins at the lower part of them, than when it begins at the upper part. A few pieces of burning charcoal placed in a grate beneath a mass of anthracite, will soon kindle the whole; but it is no easy matter to kindle anthracite by applying heat to it at the top. It has been remarked that, when clothes take fire, if the person wearing them would immediately fall and roll over, it would, in many cases, extinguish the flames; and if it did not extinguish them, they would burn with comparative slowness, and the fatal consequences would often be prevented, which result from inhaling the inflamed gas.

Construction of Chimneys.

Though the principles which should govern in the construction of chimneys do not strictly belong to the same department of science with the principles of com-

bustion, yet the near connection between the two in practice, seems to be a sufficient reason for departing from the arrangement which strict philosophical accuracy would require. A good chimney should have sufficient draught to make the smoke ascend readily, and, if coal is to be used, to keep it in a state of ignition, while at the same time it should throw out a large amount of heat, carrying up no more than is necessary to produce a sufficient draught. Could a chimney be constructed by which all the heat of the fire should be thrown out into the room, while all the volatile products of combustion were carried up, and all the smoke burnt, it would leave nothing to be desired in relation to the objects accomplished by it. But this is not to be expected, for it is only heat that, by making the air in the chimney lighter than the external air, and thus causing it to ascend, produces the draught. Still there is doubtless a very great waste of heat in many chimneys, as at present constructed. In some of them, the current of air which comes out at the top is almost hot enough to make water boil. There are various circumstances which affect the draught of chimneys, and the heat given out by fire-places. Attention to these would doubtless do much to remedy the evils of smoky chimneys, and fire-places which give out little or no heat. A brief allusion to some of these is all that our limits permit.

The height of a chimney exerts a considerable influence on the strength of the draught. For the longer the column of warm air in the chimney is, the greater will be the difference between the weight of that column and that of an equal column of external air; and the force with which the external air presses in will be proportionally increased. The chimney may, however, be so long that the current of air will be cooled before it reaches the

top, and then the increase of length will make the draught less; for, as has been already stated, smoke, when cold, is heavier than air. Hence very long stove-pipes do not usually carry smoke well, especially if they extend mostly in a horizontal direction; for the smoke in the horizontal part of a stove-pipe is moved forwa d by the pressure of the air in the other part; and if the horizontal part of the pipe be long, and the other part short, there is a long column to be moved forward by a small force. The degree to which the air in the chimney is expanded, has a very important influence on the strength of the draught. Hence, in many cases, a chimney which smokes when the fire is first kindled, and when the air is of course cold, carries smoke well after the fire has warmed the air above, and thus rendered it lighter than the air in the room. The less air enters above the fire, the stronger, other things being equal, the draught will be. For all the air that enters so that it passes through the fire, is greatly rarefied before it goes up the chimney; but the cold air which enters above the fire tends directly to reduce the warmth of the ascending current, and thus to render that and the external air more nearly equal in weight. On this principle, smoky chimneys are often made to draw by placing a board or a plate of iron over the upper part of the fire-place. This prevents so large a quantity of air from passing into the chimney above the fire, and thus increases the draught. We see the operation of the same principle in the fact that the draught of a common stove is much greater when the door is shut than when it is open. For when the door is shut, all or nearly all the air that enters passes through the fire, and thus is rarefied. Some kinds of stoves are so constructed that the air which they need comes from without the house. By this, two advantages are gained;—the differ-

ence in weight between the ascending current of air and that which presses in is made greater, and the pressure of cold air into the room through crevices, &c. is lessened. For there being no pressure of air from the room into the fire, the pressure into the room from without is of course diminished. The frequent and rapid changes of air and temperature produced by large chimneys are doubtless injurious to health. No more air should be allowed to traverse a fire than what is necessary to support combustion. Any additional quantity is injurious in two respects; it wastes heat, and tends to make the temperature of the room vary more rapidly.

Chimneys are frequently made to smoke by the action of other chimneys upon them. Thus in a close room with two fire-places, if a fire be kindled in one fire-place, a current of air will pass down the other, to supply the place of that which is rarefied and made to ascend by the heat. If a fire be then kindled in the other fire-place, it will probably smoke. If, however, a door or window be opened, so as to let in a current of air colder than that in the room, the smoke will ascend in both chimneys, unless the air moves in such a direction as to blow it out into the room. But if a door be opened into a room warmer than the one from which the smoke is to be driven, the evil will be increased rather than diminished; for the air will tend to move from the colder to the warmer room, and thus the tendency of the air to descend down the chimney into the colder room will be increased. Houses which are situated at the foot of steep hills, or very near to loftier buildings, are apt to be smoky. For when the wind blows against the hill or the loftier house, it becomes condensed by its pressure against them, and tends to descend by its own increased weight and elasticity.

And when it blows in the opposite direction, it will often pour over the hill or the loftier house, like water over a dam, and rush down the chimneys of the house thus unfortunately situated.

Count Rumford lays down the following rules for the construction of fire-places:—" 1. The throat of the chimney should be perpendicularly over the fire, as the smoke, vapor, &c. which rise from the fire naturally tend upwards. By the throat is meant the lower extremity of the chimney, where it unites with the upper part of the fire-place. 2. The nearer the throat is to the fire, the stronger will be the draught. 3. Four inches is the proper width to be given to the throat of a chimney, reckoning from the inside of the mantel to the back of the chimney." It is proper to observe that, in regard to this, much depends on the kind of fuel which is used. Green wood, which, besides smoke, sends up a large amount of watery vapor, requires a larger throat than other kinds of fuel. Anthracite coal, which sends up scarcely anything but the carbonic acid produced by its combustion, requires the smallest. " 4. The width given to the back of the chimney should be about one third of the width of the opening of the fire-place in front. In a room of middling size, fourteen inches is a good size for the width of the back, and thirty-nine inches for that of the opening of the fire-place. 5. The angle made by the back of the fire-place and the sides or covings of it should be 135 degrees, which is the best position they can have for throwing heat into the room." For thus the rays of heat which are thrown from the fire towards the side, in a direction parallel to the back, will be reflected directly forward; and the other rays more or less obliquely in various directions, diffusing heat over all parts of the

room. "6. The back of the chimney should always be built perfectly upright. 7. Where the throat of the chimney has an end, that is to say, where it enters into the lower part of the open canal of the chimney, there the three walls which form the sides and the back of the fire-place should all end abruptly, without any slope. This will render it more difficult for any wind from above to force its way through the narrow passage of the throat of the chimney. The back and covings should rise five or six inches higher than the breast of the chimney. 8. The current of air which, passing under the mantel, gets into the chimney, should be made gradually to bend its course upwards, by which means it will unite quietly with the ascending current of smoke. This is effected with the greatest ease and certainty, by merely rounding off the breast of the chimney." When this is not done, the current of air which passes under the mantel strikes the ascending current of smoke nearly at right angles, and therefore tends to drive part of it down. And not only so, but the mantel itself, when the breast of the chimney is not rounded off, tends to cut the column of smoke in two, and throw part of it out into the room. Many a smoky chimney exhibits the operation of this principle.

When we consider that man is furnished with means, and endowed with power, by which he can, at pleasure, bring into operation heat that was before concealed and inactive—that he is able to regulate the heat thus brought into action, increasing or diminishing its amount as he sees necessary—and when we think of the influence thus exerted on human happiness, the evidence of benevolent design in the Creator is too manifest not to be seen by

all who are willing to see it. Were it not for this power of producing heat by artificial means, and of controlling it when produced, a large part of the earth would be wholly uninhabitable; and that part, too, which is now inhabited by the most enlightened nations, and which seems to be best calculated for the full development of the human faculties. In addition to this, the aid which the heat produced by combustion affords in the avocations of domestic life, in the softening of refractory metals, in the progress of the arts, and in many other cases too numerous to mention, clearly exhibits the benevolence of the Creator, and strongly urges the just claims which he has to the gratitude and adoration of his creatures.

GRANITE ROCK.

BY SAMUEL FISH.

Rocks. Species used in building.

In passing through the country, at a distance from any populous city, nothing appears more useless than the rocks scattered promiscuously over the ground. With people in general, there is no beauty perceptible in them, and no interest taken in the examination of their respective varieties. They are looked upon as an incumbrance, rather than as an article of usefulness.

By the scientific and the artist they are viewed in a different light. The geologist takes an interest in them for the sake of the information they furnish in regard to the formation of the globe; the sculptor and architect for the use which is made of them in the arts which they respectively practice.

Though granite, particularly for architectural purposes, is used more extensively than any other species of rock, yet other kinds are abundantly used, not only for building, but for a great variety of purposes. Primitive limestone, sometimes called statuary marble, is a valuable article for statuary purposes; porphyry is an excellent, though expensive article for the columns of splendid edifices; clay-slate, from its being easily separated into sheets, is much used for the outside covering for the roofs of houses; gypsum, or plaster of paris, is used in agriculture, and transition limestone, for the purpose of making quick-

lime, for a building stone, and for slabs to fire-places, tables, &c. The uses to which the different kinds of rocks are applied, are too numerous to mention.

Granite is but a single species of the great variety of rocks belonging to the globe we inhabit. To give a proper idea of this substance, it will be necessary to enter into some account of rocks in general. A person taking a careless view of the rocks scattered over the earth, would consider them too numerous to admit of a systematic arrangement. A more careful observation shows this to be a mistake. Nothing is more easy than to arrange them into distinct classes, and exhibit them under their appropriate names. Though they seem to exhibit an endless variety, they are all composed of about nine different minerals. The various combinations of these minerals, or simple substances, is what principally occasions this variety.

Until within a few years, nothing has been so much neglected as this branch of natural philosophy. Mankind, to a very great extent, have been contented to live in ignorance in regard to the component principles of the globe. Very inaccurate and inconsistent ideas have been entertained in respect to rocks. Some persons suppose that they have ever existed just as we behold them at the present day. Others suppose that they grow—vegetate like plants. Even the great Mr. Locke, the most profound *metaphysical* philosopher that ever lived, entertained such an idea.

Though they cannot be said to grow, they may be said to be formed—just as many other things are formed—out of materials which previously existed. All that now composes the rocks, existed at some ancient period in the form of something else. The outer shell or crust of the *earth,* as it is commonly called, was consolidated out of a

very different material or of different materials, to prepare a place for the residence of animals and the growth of vegetables. The outer shell or crust of the earth does not always exist in the same form. All that is now loose soil, in Geology called diluvium and alluvium, has existed in the form of rocks, and much that is now in a consolidated form, has existed in the form of diluvium and alluvium. From certain causes, with a considerable portion of the outward crust, there have been alternations in this respect. From the effects of the atmosphere, the attrition of rain, running streams, the beating and rolling of the ocean, frost, and a variety of other causes, solid matter has been broken down and pulverized; and from protracted rest, heat, pressure, a cementing principle, and other causes, loose soil has been consolidated and converted into thick beds of rocks.

All the different rocks upon the surface of the globe are divided into four classes. The names of the four classes are, primary or primitive, transition or intermediate, secondary, and tertiary. Besides these, some geologists have a fifth class, called quaternary, but generally what are called quarternary are included under the head of tertiary. These were formed, one after the other, in the order they have been named.

There have been a great number of theories formed, in regard to the earth, some of them so inconsistent as to be exploded as soon as they were promulgated. Those theories which have borne the test of the greatest scrutiny, are what has been called the Neptunian, which accounts for all the rocks from a watery origin, and the Vulcanian, which ascribes them to an igneous or fiery origin. Some persons are averse to theories; and when they are not founded on facts and rational principles, they *do* only serve to mislead. It is difficult, however, to com-

municate information to any great extent without some regular theory.

The Vulcanian theory, which ascribes the formation of the rocks to an igneous origin, seems to have the most facts to support it; and that is the theory most believed in by those who have had the best opportunity to judge.

According to this theory, or that modification of it which seems to be the most rational, the earth was once an entire body of igneous materials. It existed in this state for a long time; and when the heat at its surface was sufficiently dissipated, it began to be incrusted over, just as water freezes, when the temperature of the weather is below 32° F. This incrustation extended deeper and deeper, until the whole of that class of rocks was formed denominated primitive. This, to judge from appearances, took place when the earth was comparatively in an undisturbed state; and the consolidation extended round the entire globe. The other rocks were formed afterwards, from different causes, and in a different manner.

From a variety of circumstances, and a multiplicity of evidences, we have the greatest reason to suppose that the earth, since it was first spoken into existence, has undergone many great changes. The account of the creation given by Moses shows this. Its primordial state, according to this sacred historian, was "without form and void." This was its embryo state, and was probably a very different state from what some people imagine. The second state, as mentioned by the same historian, was when a firmament was formed. The third state was when the waters under the whole heavens were gathered unto one place, and the dry land was made to appear, so that the earth brought forth grass, herb yielding seed after his kind, and fruit-tree yielding fruit after his kind. The fourth was when lights were placed in the heavens,

when day was divided from night, and when days, and seasons, and years, were meted out by the heavenly bodies. The fifth was when the waters brought forth abundantly the moving creatures that have life—whales and everything that moveth in the waters, and every winged fowl after his kind. Creatures which could scarcely be said to have life, and that could not be called *moving* creatures, such as corallites and other un-locomotive animals, were doubtless created when the earth was in a different state. The sixth state was when the larger and more perfect land animals were created—cattle, other beasts of the earth, and man. This shows that the earth has existed in different states. The only difficulty is to explain how all these changes could take place in so short a space as six days. The most rational method is, to suppose that time was not measured then as it is now. The sun and moon were not created until the fourth day; of course it is irrational to suppose that it was measured by days, and months, and years. Furthermore, one day with the Lord is as a thousand years, and a thousand years as one day. A rational account of all these states and changes could be exhibited, coinciding with the geological construction of the globe, but it would prolong this essay to too great an extent.

There are other changes which it is necessary to speak of. The first, or primordial state of the earth, might with propriety be subdivided into three states.—First, when the epithet "without form and void" would with most propriety apply to it; second, when it was in the form of a fiery abyss; and third, when it was in the form of a watery abyss. The last was that form of it, previous to the time when the waters over the whole earth were separated unto one place, and the form which has so often been spoken of under the name of the "watery abyss," by philosophers of every age.

The existence of a fiery abyss is proved from a great variety of circumstances, and acceded to by the most enlightened geologists. Formerly, such a belief was thought to be unconformable to the sacred oracles, but latterly it is supposed to coincide with them. The most prominent evidences of the earth's having formerly existed in the form of a fiery abyss, are the facts that the primary rocks have the appearance of an igneous origin, the evidences of a tropical temperature having formerly existed in high northern and southern latitudes, and the increase of temperature in the descent into the internal parts of the earth. There are innumerable evidences to show that the earth is in a state of igneous fusion at its centre at the present period. This, with the testimony which has been adduced, is sufficient to establish the fact that it was formerly an entire body of fire.

The primary rocks having been composed first, formed the basis of all the other classes. They were formed as before stated, by the cooling and consolidation of the mass at its surface, just as water freezes. As they are not all alike, the circumstances under which they were formed were sufficiently unlike to account for this want of conformity. The other classes were formed afterwards, succeeding each other in the order they have been mentioned. They are supposed to have been formed of the three-fold combination of the ruins of former rocks, volcanic and sub-marine eruptions from the ignited mass, and fossil remains. Being composed at different periods, and the materials of which they were formed being somewhat different from each other, there is sufficient variation in their construction to render it proper to divide them into classes.

What is meant by former ruins, is the broken and pulverized condition that large portions of rocks have *from* the earliest periods existed in. From what might

be called an elemental strife, rocks in many places were broken in pieces, lifted from their former positions, jammed and dashed against each other, and pulverized to atoms. These, when the other materials which have been mentioned had become mingled with them, and they had reposed long enough to become consolidated, were reconverted into rocks, and one after the other of the classes were formed according to the period when they were brought into existence. Should all the loose soil now reposing upon the more solid materials of the earth, mingled as it is with fragments of former rocks, volcanic eruptions and fossil remains, be thus consolidated, it would form a class similar to those which were formed in succession to each other after the primary class.

Notwithstanding the different classes were composed one after the other, reposing upon each other as they were formed, yet when our observation is extended to those which are in view, we find them in many places jumbled promiscuously together—all the different classes mingled upon the same spot. Lest this should not be fully comprehended, a little further explanation will be devoted to this particular.

It has been seen that the earth has not always existed in that uniform, quiet, and unchanging condition we are inclined to suppose. Changes are continually taking place in our own times, and history informs us of greater changes than any which are known to predominate at the present period. Judging from this, and from what seem to be certain criterions of change, they existed in a greater degree previous to the period when history began to record the facts, than since that date. Wherever we cast our eyes, we behold something to convince us of this. A large portion of the smaller rocks seem to be only fragments of larger ones. Rocks, wherever they are found,

exhibit marks of violence and agitation. Blocks of granite and other formations, seeming to be only portions of larger rocks, present themselves in detached masses. However large the mass, or however extensive the bed, wherever such rocks are seen, the same thing is observed in them. Rough and broken edges are sure accompaniments of those which are detached, and seams, and ruptures, and fissures, of those which are only lifted from their original beds. Wherever a bed, a cliff, a ledge is beheld, time has altered it, violence has operated upon it, and change has marked it. Even the mountain ridges and lofty eminences exhibit marks that show that they were not always such. Cragged and broken, they throw up their towering peaks and precipices; and in a ruptured condition, let fall their loosened fragments, like dilapidated edifices falling piecemeal to the ground. The towering Alps, the extended Apennines, the lofty Andes, if the marks of violence depicted upon them are the same in those which they are in other things, were not always what they now are. The earth has been convulsed, rocks which were once entire have been ruptured, and formations which were beneath all others, have been elevated. In this way, granite, which was created first, has been thrown up to take its place with rocks which were created last.

A little reflection will exhibit to the experienced observer the cause of this, as well as the cause of all the most important changes upon the globe. The igneous mass, which furnished materials for the primary rocks, still exists at the centre of the globe, and is, and ever has been, the prime mover of every disturbance. Water mingled with this mass, issuing through the crevices of the rocks, operates by expansion, after it has been converted into steam, to rend the hardest adamant and upraise the loftiest

eminences. Some are merely broken, being raised only far enough to produce this effect. Some are raised so high, and are of such steep ascent, that large masses are detached, and precipitated to regions below. In some places there is a perfect bursting—or more properly, a propulsion of rocks from their nethermost beds, so that those which lie beneath all the rest are raised above them all;—just as when a quire of paper is divided by a sharp instrument, and the two portions are raised where such division is made, the lowermost sheets which before were concealed, are lifted into full view; and just as when a globular body of any kind, from some impulse from the centre, is so operated upon that its central portions open for themselves a situation upon the surface.

Innumerable situations upon the earth's surface may be seen where this has occurred. Granite, from such a cause, crops out, as it is called, upon the mountains and lesser elevations. More than half the granite scattered over the earth is of that kind which once existed beneath the superincumbent mass. Earthquakes, like those which have occurred within the remembrance of people now upon the stage, were among the immediate, as were internal fires the remote agencies of these things. The jar of an earthquake, the seat of which was at Lisbon, was felt over one quarter of the globe, and land at the same time was permanently elevated in some places, and swallowed up in others, never to be seen any more. Volcanoes, two hundred of which are now in existence, are powerful agents in changing the condition of the globe. Two hundred active volcanoes, and as many thousand extinct ones, go far to show what has been effected by these powers alone.

Not all the rocks of the granitic class situated upon the earth's surface, are those which were propelled from

beneath. Over extensive regions none but the primary class was ever formed, and over no inconsiderable spaces, none but the granite. Changes which had taken place in relation to the ocean, lakes, rivers, mountains, &c., so affected the external condition of the globe, that the other classes were more or less restricted, according to the extent of those changes, and the period when those classes were brought into existence.

One thing more ought to be mentioned, previous to entering upon a more particular account of the variety of rocks under consideration. Rocks of irregular and broken edges, and large beds and swollen ledges have been spoken of. Besides these, stone and rocks of a round, oval or irregular shape, with smooth surfaces, presenting themselves in extensive beds, are found in great abundance. They appear of different sizes, from the pebble that weighs but an ounce, to the boulder of the weight of a ton. They exist not only upon the surface, but at considerable depths beneath. They are found in gorges, ravines, valleys, plains, and sometimes, but not often, upon high mountains. They were worn round, smooth, &c., by being rubbed against each other through the instrumentality of water. Rivers have run in channels now exhibiting but few marks of such a circumstance; lakes have spread themselves in situations, and rippled upon shores, where, unless to the close observer, there are no signs of their having existed; oceans have rolled their waves upon regions where now the uplifted mountain sends its towering summit to the sky.

Primary rocks are said to compose the frame or groundwork of the globe. They compose the most lofty mountains, and, as said before, form the basement of all other rocks, descending to the deepest foundations. They cover vast spaces where no other rocks ever existed; and from

having been propelled through other formations, show themselves in places where they never could have been situated, but from an all-powerful cause beneath. They exist in many places merely from such a cause, and in others from having been carried there by inundation, which more than once has swept over the surface of the globe.

The primary rocks are divided into granite, gneiss, mica-slate, clay-slate, primitive limestone, called sometimes statuary marble, porphyry, and sienite. Granite is the most important species belonging to this class; and from its having been first formed, exists in the greatest abundance. It even covers over spaces where no other rocks abound, showing, from causes that admit of an easy explanation, that only a single species of rocks were formed over some extensive surfaces. Granite crops out, as it is called, at the tops of a great many mountains, and forms in others their entire bulk. It appears in detached masses, where it has been carried from its native regions by inundation, clustered together in small fragments in many places, and as the principal or only rock over large tracts of country. The state of New Hampshire is called emphatically the granite state, from the predominance of this material. It is used to a great extent as a material for building, much more, especially in this country, than formerly. Many of the most noted edifices in the city of Boston are composed of it. The old United States Branch Bank, facing State Street at the head of Wilson's Lane, is composed of granite. This building is forty-four feet in front, and ninety-six feet deep; the portico is an imitation of the primitive form of the Grecian Temple; the columns are of the Grecian Doric, four feet in diameter, and twenty-four feet high, the shafts of which are entire. The granite of this edifice was brought from Chelmsford.

The County Jail in Leverett Street, the House of Correction connected with it, and the Municipal Court House, are formed of granite. The Massachusetts General Hospital, considered the finest building in the state, one hundred and forty-eight feet by fifty-four, having a portico of eight Ionic columns in front, is composed of Chelmsford granite. St. Paul's Church, situated upon Tremont Street, fronting the Common, built in imitation of the Grecian model of the Ionic order, is composed of gray granite. The Boston Exchange Coffee House, then the most spacious and most extensive establishment of the kind in the United States, finished in 1808, and destroyed by fire in 1818, was of granite. The New Court House, and the front of the Tremont House and Tremont Theatre, are of granite. An elegant block of stores upon Water Street is of this material. The basements and front posts of many of the blocks of stores now building, and private houses too numerous to mention, are of granite.

Another important edifice composed of this material is the New Market House. This is the most superb building of the kind in the world. The centre of it is seventy-four and a half feet by fifty-five, the wings two hundred and thirty-one by fifty, and two stories high. The wings have each a portico of four columns, three feet seven inches in diameter, and twenty-three feet high, the shafts of which are of granite, and in a single piece. The whole of this structure is composed of hammered granite, of a uniform appearance. The posts around the Common in Boston are of granite, likewise the posts and wall around the State House. That useful, expensive and noble work, called the Dry Dock, in Charlestown, is of granite—likewise the State Penitentiary in that place.

The State House at Montpelier in the state of Vermont, the noblest specimen of architectural grandeur in the

United States, is formed of granite. It is a structure of great expense. The columns of the portico, six in number, each shaft of which is composed of six pieces, cost, after the rough material was delivered upon the spot, what amounted to thirty-six years' labor of one man. The site of this edifice is upon a spot where formerly existed a high granite cliff, removed at great expense expressly for this purpose. It is, therefore, not only composed of granite, but founded upon it. Unless some unforeseen disaster should befall it, it will be likely to exist for ages. Good judges have asserted that it is susceptible of existing in a tolerable degree of preservation, upwards of two thousand years.

The great use made of granite may be estimated from the large number of workmen continually employed in hammering it, and fitting it for its destination in this city, and from the vast quantities of the rough material deposited upon so many of the wharves in Boston. When fully fitted for use, it is worth from fifty cents to a dollar a foot. A great part of what is used in Boston and its vicinity is brought from Quincy, by way of the Quincy Railroad, and is called by the workmen the Quincy Blue. It is brought from Chelmsford, from Medford, from the state of New Hampshire, from Green Bay, and some other places.

The first operation performed upon granite is called quarrying, which is merely splitting it into blocks at the ledge. It is done by drills, wedges and sledges. Holes by means of the drills are made in a straight line, in some large block, two or three inches apart, with every third hole three inches deep, and the others more shallow. When this is completed, small wedges are driven by a sledge into these holes, and the rock split with as much facility as a block of wood. The next thing to be per-

formed, is to transport it to some convenient place in Boston, Charlestown, Cambridge, or elsewhere, to be hammered. Those who hammer it, must each of them have their hammers, chisels, and some other tools. It is lined by a sort of chisel, faced by the facing hammer, further operated upon by the pean hammer, and finished by the bush hammer.

The chief use made of granite in the country, besides the use made of it in common with other stone for stone-wall, is for the underpinning of houses, and posts for board fence. For the latter purpose, the use made of it has greatly increased within half a dozen years. In many places it may be split out into blocks of the proper dimensions, and delivered upon the spot for twenty-five cents for each post. In some places, however, the procuring it is much more costly than in others.

Granite is a compound rock, composed of three distinct minerals, aggregated into a solid form. The names of the minerals are quartz, felspar and mica. Quartz has commonly a white color, a glossy lustre, and does not separate into layers when broken; generally it forms the greatest proportion of the granite; very often it is found pure, and sometimes in the form of large, very beautiful crystals. Felspar is of a yellowish or milk-white color, and when broken, divides into layers of considerable thickness, with smooth, shining surfaces. Mica is sometimes white, but more generally of a dark green color. It consists of thin, flexible leaves, adhering slightly together, but easily separated. It is known by the name of isinglass, and when existing in large plates, is used for lights for ships, windows for stoves, and lanterns. All these three ingredients of granite are very often found in a pure separate state. In some rocks, specimens of all these may be found in different parts of them, of no inconsiderable size.

Granite never consists of layers or strata, like gneiss and mica-slate. Being crystallized and compounded of the three ingredients before mentioned, it is of a granular form. The grains are larger or smaller in different rocks. In some, the grains or crystals are a foot in diameter; in others, no larger than a grain of sand. The coarse-grained is generally the least durable, and of course the least proper for architectural purposes. Granite, gneiss and mica-slate are composed of the same materials, or simple minerals, but differently combined. The two latter are composed of smaller grains than granite. In gneiss and mica-slate, the felspar and quartz are aggregated closer together, forming strata or layers, with intervening scales of mica between them. Mica-slate is chiefly composed of quartz and mica. The mica, commonly in fine scales, predominates.

Granite is of all colors, from almost a perfect white, to a bluish, and even purplish color. It may be distinguished from the rocks of the other classes by its granular and crystallized form; from gneiss, from its less perfect crystallization, and from not being composed of layers; and from mica-slate, from the latter being more stratified and of a slaty structure.

What the difference of cost between granite and brick as a building material is, cannot at this time be determined for want of data. It is evident, however, that the bare cost of granite, wrought in blocks and hammered, is the greatest. In regard to beauty and durability, to the granite must be awarded the pre-eminence. The rough material, where its transportation is not from too great a distance, to judge from mere conjecture, must be cheaper than brick. The grandeur of even *this* is superior to that of brick, and it may even be said, of the hammered stone. What appears more grand, solemn and majestic,

than a number of the churches in the city of Boston, with their stately walls, their uplifted turrets, and towering spires, which are formed of granite in its native form? There is a grandeur in them that ever so much labor can never reach. There is a grandeur that inspires the mind with awe, and carries it back into remote antiquity. What a labor-saving business it would be to form all our houses of stone, at the same time paying more attention to them, to guard them against the devouring element of fire. What grandeur would be imparted to Boston, if all her edifices were of granite, even if one half of it were just as it was taken from the field. It would be something worthy of being famed in after days. Stone is the most imperishable material we have among us, and edifices formed of it might transmit the names of their founders to a thousand generations. Cities constructed from it, like Babylon, Palmyra and Balbec, might be venerated even in ruins.

There are structures formed of stone, a great part no doubt of granite, which will probably continue in existence as long as time shall last. The Egyptian pyramids are as durable as the everlasting hills; the great wall of China has existed through many generations; and even our own Bunker Hill Monument, when it shall have arrived at its perfect stature, will tell a deed of fame to after generations, until time shall be no more.

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THEORY OF THE EARTH.

BY SAMUEL FISH.

Matter. Ideas respecting its duration.

The subject of Matter, a substance so universally diffused, ought perhaps to be taken up on a larger scale, instead of being condensed into so small a compass as to occupy but a single tract. What is here presented, however, is meant for nothing but the mere outlines—the first principles—of a subject which might be so extended as to fill whole volumes. Different opinions have existed in different ages, in regard to matter; and in many respects, it has been the subject of a great deal of different reasoning with philosophers of the same age.

The ancients, almost without exception, believed in the eternal duration of matter; while many of the moderns, especially those who do not disbelieve the scriptures, believe in its having been created out of nothing, when the world was created. The general belief of the latter is, that the Hebrew word which is translated *create*, when applied to the earth—notwithstanding it is allowed to have a different meaning, when applied to some other things—signifies absolutely creation out of nothing. It is admitted by the same persons, notwithstanding this limitation, to be synonymous with to make, to produce, to cause to be, to impart a formation to a substance already in existence.

If, in order to establish the authenticity of the scriptures, it were necessary to consider the earth created out of nothing—if the glory of God would be more promoted, by considering him the creator in this light, than by considering him the creator of innumerable worlds out of materials which before and forever existed—the infinite durability of matter should at once be discarded. There is apparently, however, no necessity of considering God as the creator of all things out of nothing. To *us*, he would appear as great to be the modeller—the maker—of worlds and all other things, in the same sense as a man is the maker and builder of a ship, a house, a citadel.

There is a difficulty in believing otherwise, because it is difficult to conceive of a time when the universe was an empty void—when all the shining orbs which are suspended and move and roll in it had not a being—when there was nothing, no universe—when God, the great creator, existed—where? We cannot tell where, when the extended universe was a blank.

We can conceive of matter being changed into an invisible form—invisible to such optics as man is possessed of; but it is difficult to conceive of its non-existence—of its existing in no form. If we look back to the creation of the world, supposed by many to be but six thousand years ago, it is hard to suppose that all matter originated at that time. Let the creation be removed as far back as some geologists are disposed to carry it, and it is but a little while, in comparison with infinite duration. To say that there were no worlds in existence before that time, would be saying more than any, upon serious reflection, are prepared to say. To go back millions and millions of ages, we are no more prepared, upon due reflection, to say that the universe was then an empty void, than to say the same of it yesterday, last year, or six thousand years ago.

We may for a moment think of a time when nothing existed—that is, nothing of a material nature—but upon a little reflection, it is difficult to obtain the assent of the understanding to such a thing. If all which our eyes behold, and which beings of higher attainments and superior faculties behold, adds anything to the glory, majesty and power of God, he is greater now than he was before matter was ushered into existence, which would make him changeable; and this is contrary to reason and divine revelation. To say that he possesses the power of alternately destroying and re-creating matter throughout the universe, would be easier to be believed; but this would not help the subject, and would be less reasonable than to suppose matter always exists—but that it is continually, in some place or other, receiving new forms. Setting aside such a disquisition, as it might be thought by some to lessen the power of the Creator, one thing will be insisted on, which is, that matter has existed more than six thousand years, and longer than the earth has existed, if that has had a being millions of ages longer than has been generally supposed.

Much difference of opinion has existed among philosophers, in other respects, in regard to matter. Democritus, an ancient Grecian philosopher, believed it to be intelligent in many of its corpuscles, and unintelligent in the rest. Aristotle and Plato believed it to be intelligent as a whole, but unintelligent in its separate parts. Epicurus believed it to be unintelligent in all its particles, whether united or disjoined. A second class, who have been called Materialists, believed in its emanation from the essence of the Creator. This class includes a great many of the ancients, and a considerable part of the world at this present period. Several eminent French, German and English writers of the last century supported such a

sentiment. Pope, in his celebrated Essay on Man, expresses his sentiment in regard to it in the following lines:

"All are but parts of one stupendous whole,
Whose body nature is, and God the soul."

It constitutes the religion of a great part of the people of the East. Brahminism and Buddhism are founded upon the doctrine of the emanation of matter from the essence of the Creator.

A third class believe there is no such thing as matter, or a material and external world. The existence of man is supposed by them to consist in nothing but impressions or ideas—or pure, incorporeal spirit, which surveys everything in the same unsubstantial manner as the visions of a dream. This doctrine is very absurd. But absurd as it is, it has had its supporters in ancient and modern times. Malbranche wrote in a manner that indicated such a belief. Bishop Berkley and Hume were strongly impressed with such a sentiment.

Such things afford but little information in regard to what matter really is. If they could be considered as brushing away the rubbish, to come at the real truth, one great end would be answered. Truth lies deep. Those who are in pursuit of it, therefore, must search deep to find it. If every one would be as earnest to dig and search for it as to heap rubbish upon it, its attainment would be a great deal less difficult. Much of what is said upon any subject is so far-fetched, dear bought, and made up of such incongruous materials, that the thing intended to be pointed out is the least conspicuous of any part of it. After wading through heavy volumes, *we are* oftentimes made but little wiser for all our *labors.*

Nature should be rather followed, than directed to go at our command. Were we as ready to follow her, as to violate her laws, we should be more enriched by her precious lore. She is more simple in her operations than we are generally aware. There is a thread or line, which, if taken for a guide, will lead us through the most intricate labyrinths. Such a connection exists through all the operations of nature, that the discovery of one thing opens our view to another, ad infinitum. A knowledge of what is near, throws light upon something far off, and even beyond the ken of human optics. A few simple laws, well understood, relative to one particular substance, enlightens the understanding upon every other substance. A knowledge of some of the most important properties of caloric, opens to view fields beyond the solar regions, and as high in ether as human thought can soar. Those bodies, which, in their periodical visitations to the solar system, excite so much wonder, denominated comets, if carefully observed, show us what may be estimated as fact in regard to the origin of worlds, and the successive changes they pass through to reach their final destiny. The different appearances of comets throw light upon the origin of worlds, and upon the new forms that matter is continually assuming. Some comets exist in such an attenuated form that they are sufficiently transparent to admit of other bodies being beheld through them. Others are endowed with greater density, and others are perfectly opaque. Those that are perfectly transparent are probably in an aeriform state; those that are partially so, are passing from an aeriform to a different state, and those that are perfectly opaque have in their turn become solid, or are progressing through the intermediate changes from an aeriform to a solid consistence. As those endowed

with the least density were probably created last, a slight knowledge of their comparative ages may be obtained.

From a particular fact which has been ascertained in regard to planets, an inference may be drawn that these were once comets, and that the comets are constantly progressing from a cometic to a planetary state, in the latter of which they will undoubtedly exist, when a sufficient time shall have elapsed to afford them opportunity to become properly developed. The fact referred to is the change which is taking place relative to the orbits of the planets—a change that imparts to them continually a more circular rotation than they have had before. This change, though it has not been strictly ascertained, may be supposed to exist in regard to comets, and may be adduced as another proof of their regular metamorphosis from a cometic to a planetary state.

Other things of great importance to philosophy may be inferred from an attentive observation of the heavenly bodies. The disappearance of stars in one part of the heavens, and the introduction of new ones in other parts, shows that former worlds, if not continually, are frequently struck out of existence, and new ones ushered into being. Such are some of the evidences that matter changes, or varies its form, and that its origin is not recent.

To give a more particular definition of matter, and treat of some of its attributes, it may be asserted to be everything that is not mind, that is not spiritual, that is not immaterial. It exists in different forms, and may be considered as extending through all space. It exists in a solid, in a liquid, and in an aerial form; likewise in forms vastly more subtle and attenuated. It frequently and continually, in some way or other, changes its form. The same material which exists to-day in a visible form, may

to-morrow be totally or in part invisible—or next week or next year be millions of miles from where it had existed before. Worlds are struck out of existence, and are dispersed in an invisible state over a vast extent of space, or become component parts of new ones. New worlds may be derived from older ones, in a manner somewhat analogous to what takes place in the animal and vegetable kingdoms.

A beginning, progression to maturity, decline and end, happen to everything. The minutest insect has its entrance into this wide domain, a transitory existence in it, and its exit from it. The wide-spread oak was once an acorn, and it will in time be mingled with the dust, not to be distinguished from the common mass of earth. Man, the boast of creation, the most perfect, according to his own estimation, of all the works of his Creator, passes through different changes, until he is re-converted to his native element. The everlasting hills once did not exist; we now behold them crumbling to ruin, and the time will come when they will not be. All the innumerable worlds, glittering like diamonds in the firmament, have, like man and everything else, their moments assigned them; and the time will come, after they shall have passed through their respective changes, when they shall be blotted out of the universe.

It has been stated of matter that it exists in different forms. That which most attracts attention, and appears to be most important, is its solid form. A great part of the earth is solid—an equal proportion, perhaps, of the other planets, and probably, though it is very uncertain, a small part of some of the comets. Besides these, worlds belonging to other systems are doubtless to a greater or less degree solid. The sun and the fixed stars are probably in an ignited state, and liquid from fusion.

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The next apparently most important form of matter is liquid. Everything belonging to the earth of an aqueous quality, excepting what is near the poles, is during the greater part of the time liquid. Other substances are likewise in a liquid state; and the whole earth, according to common appearances, was once liquid from ignition.

The next upon the descending scale, or that which appears to be descending, is aeriform, or in the form of air. This is invisible, and includes the whole of the earth's atmosphere. Formerly, or when the earth was in an ignited state, it was more abundant than at present. Before this, to reason from analogy, from other things, the whole earth was aeriform; and all other bodies, at some period of their existence, are probably so. There are forms bestowed on matter, more subtle, more attenuated and ethereal, than air. Caloric, electricity and light are some of these.

That which we call solid does not from necessity in all cases exist as such. There is a change from solid to liquid, and from liquid to solid, continually taking place somewhere upon this earth. Every sort of solid substance has, by art, been converted into liquid; and every sort of liquid substance, excepting alcohol, has been converted into a solid; and this might probably be changed to a solid, if taken far enough towards the poles. Diamond, which, until lately, never has been liquefied, is the most difficult to be thus changed. Next to this is stone of all kinds; next, most of the metals, and next, alkalies, sulphur, phosphorus, &c. Lead and some other metals are very easily liquefied; and mercury, extraordinaries excepted, always so in the temperate zones. Tallow, lard, and most of the animal fats, which in a common temperature are solid, are rendered liquid if the temperature is a little increased. Some substances which are

solid in winter, are liquid in summer. Water becomes solid in a temperature below 32° F.

The same power, that is, heat or caloric, which converts solid substances into liquids, converts liquid substances into aeriform ones. Not only those which are naturally liquid are thus changed, but, if caloric be sufficiently applied, those which are liquid only when rendered so by art. The most infusible bodies—all that the earth contains—and the whole earth itself, would be converted into the form of air, if heat were sufficiently applied, and vice versa, when it was abstracted.

The first historical records we have relating to the earth, contain something to corroborate the idea that it was primordially in an aeriform state. The statement referred to is that which affirms that the earth was without form and void. What could this be but an aeriform state? Everything which presents itself to the eye has some form—vast or diminutive, handsome or ugly. Air is not susceptible of being presented to the visual organs; of course it is without form. The earth was void at that time, because it was empty—vacant—with nothing growing upon it, and containing no inhabitant.

If it should be asked by any one, how it came in an aeriform state, the question could be as easily asked how it came in any state? God was the creator, and had power to create it in what way he pleased, and to give it what form he pleased. It was as easy for him, from some natural cause, as the bursting forth of a volcano, to have it issue forth from the sun, or a body of incomparably more extensive dimensions, as to create it in any other way. He could, as many suppose, create it in the short space of time allotted for its creation; but he would not have displayed any more power by it than to have created *it in this way*, and there would not have appeared half so

much harmony in it. There is so much testimony to prove that it was created in a different way from what has generally been supposed, and has existed longer, that infidels are taking advantage of the construction put upon the scripture record, and endeavoring to prove that this record, and of course all the rest of the Bible, cannot be true. It is easy enough, however, to explain this upon philosophical principles, without invalidating the history of Moses. One day with the Lord is as a thousand years, and a thousand years as one day. The sun and moon were not created, or had not become luminaries, until the fourth day;—of course there was no way to reckon time as it is now reckoned, until then.

It would be most reasonable to consider the days spoken of by Moses as epochs, consisting of a long but indefinite period of time. To give a clear and distinct view of the subject, two kinds of epochs should be spoken of. The former should be called scripture epochs, and the latter, geological epochs. Each scripture epoch should include one day of what is considered to be the time occupied in creation; and the whole should include the six days. Each geological epoch should include the time during which one class of rocks were formed; and the whole, the time during which the primary, transition, secondary and tertiary formations were completed. It would take up too much space to give a particular account of all these—therefore nothing but a single glance will be bestowed upon the scripture epochs.

The first of these occupied the time when the earth existed in an aeriform state, the period when it existed in a state of igneous fusion, and that part of the period when it was covered by a watery abyss, which elapsed previous to its being changed from a state of chaos.

The second epoch occupied the time when a firmament

was formed in the midst of the waters, dividing the waters from the waters. The firmament is that space which we everywhere behold above the horizon. Before this, dense fogs, tremendous and continued rains, and heterogeneous materials of every kind dispersed in a boundless atmosphere, rendered the boundaries between the earth and the space above indistinct and uncertain. What are called the elements had not become entirely separated, but existed in a confused or chaotic state. The waters below had not become sufficiently divided from the waters above. A change took place, a firmament was formed, and there were intervals of repose in the atmosphere above, and continued storms did not fill the heavens with appalling war.

During the third scripture epoch, dry land slowly developed itself;—at first in small patches in the form of bogs, swamps and morasses, and afterwards in islands of greater or less extent. This was the period when the waters under the whole heavens began to be separated into one place—not suddenly, as has generally been supposed, but in the same almost imperceptible manner in which changes are brought about at the present time. The earth brought forth grass during this period—herb yielding seed after his kind, and fruit-tree yielding fruit after his kind. The vegetables of this period, the former part of it, especially, were, according to the fossil monuments found belonging to those days, of the lowest order, such as palms, reeds and ferns.

Lights were placed in the heavens during the fourth epoch, to rule over the day and over the night, and to divide the light from the darkness. The bodies which now afford light to the earth were probably created before this period, but had not become so perfectly developed as to be luminous.

During the fifth period, the waters brought forth abundantly the moving things that have life, and fowls that fly in the open firmament. They are called *moving* things, to distinguish them from the living things which were created before, that could not move. The first vestiges of animal life were created during the second epoch, but they were that kind of animals which, from the uncertainty in regard to them, whether they were animals or vegetables, have been called zoophytes, or animal plants. Besides being unendowed with the power of locomotion, they were doubtless devoid of several of the senses. Fowls that fly in the *open* firmament are spoken of, because before this time, there was no open firmament. What is now called the firmament existed before in a chaotic state, full of dense fogs, clouds, and tremendous and uninterrupted storms. Whales and everything that moveth in the waters, and every winged fowl after his kind, were created during this time. Animals that move upon the earth are not yet spoken of, because, though the waters were separated from the dry land in some degree, and the lowest kind of land animals might have been created, large islands and continents that were permanent were not separated until the next period.

During the sixth epoch, the earth brought forth living creatures after his kind, cattle and creeping things, and beasts of the earth after his kind. Man, in the image of God, and after his likeness, was created during the sixth epoch. They were created male and female, and commanded to multiply and replenish the earth.

These epochs and these subjects would supply materials for a long dissertation, but they must be dismissed, to afford opportunity for the geological epochs to be discussed.

The first geological epoch will be supposed to commence when the earth had changed from an aeriform to

a liquid ignited state; or to speak more familiarly, when it existed in the form of a red hot ball of fire. Causes similar to those which cause condensation at any time, had so operated upon it as to convert it into this state, by the extrication of latent heat, and presenting it in its sensible form. When it had existed in a liquid ignited state a long time, long enough for the heat at its surface to become sufficiently dissipated, a solid crust began to exhibit itself around it. At first it was superficial, scarcely perceptible, and nothing but a mere pellicle. By degrees it increased and extended itself in depth, just as ice extends itself upon a lake or any other body of water, when the temperature is below 32° F. In time it arrived to the depth of a foot, a yard, a furlong, several miles. After the lapse of a sufficient period, the whole of those rocks which have been called primitive, were formed. They were formed by crystallization, just as crystallization of any substance takes place. From a more equable temperature existing over the whole earth then than now, they were formed in a comparative state of repose, and the earth presented a level surface. That they were formed in this way is rendered probable, first, from their crystallized state, which is different from that of the rocks which were formed afterwards; second, from the position in which they are found, which differs from that of other rocks; third, the probable, not to say certain condition of the earth at its centre, at the present time, which, from an abundance of evidence, is proved to be igneous.

Other proofs that these rocks were formed in this way could be presented, but these will be deemed sufficient. Different from what are found in rocks which were formed afterwards, no animal remains present themselves in these rocks. Animals of course were not created until after this epoch. The primitive rocks exist in great

abundance upon the surface of the earth, and great use is made of them for architectural and other purposes. The most of this class are included under the names of granite, gneiss and mica-slate. A new state of things existing, a new epoch commenced, which, for the sake of exhibiting things methodically, is here called the second geological epoch.

The rocks formed during this period, from the circumstance of the earth's passing from an uninhabitable to a habitable state, are called transition rocks. During the period when the primitive rocks were formed, there was no rain upon the earth, no ocean, and no water of any kind. The substance of the earth was so hot that water could not exist upon it; and every particle which now exists, existed then only in the form of a vastly extended atmosphere. When the temperature at its surface was sufficiently reduced, the atmosphere was more and more condensed to descend in rain, and an ocean was formed over its entire surface. It was not necessary that the temperature, to cause condensation and rain, should be reduced as low as what would be necessary now; for the pressure of so boundless an atmosphere would cause this, when the water which descended was even above what is now considered the boiling point.

The rocks of the transition class would be formed in the following manner:—The ocean surrounding the earth, from its effects upon the crust, would in some places pass through and mingle with the mass beneath. This would create disturbance; the crust would be broken up in many places, and from the washing, jarring, and warring of elements, the ponderous masses and smaller fragments of the first formations, by striking and grinding against each other, would be pulverized to atoms to create materials to assist in the construction of new formations. From the

minutest particles originating from these collisions, clay slate would be formed; from the coarser powders, grit-stone; from small fragments which were angular, breccias; from the larger fragments which had become in part rounded from collision, conglomerates—the general name of the whole of which is graywackes.

Besides these, the inrushing of water into the boiling mass would cause further congelation. These congelations, by mixing with the massive fragments of the former rocks, and being broken up and pulverized with them, would, together with animal remnants which were deposited at this time, afford materials for the whole of this class of rocks. The animals evolved at this time, were of the lowest orders; nothing but mere vestiges of animal life; so imperfectly developed as to render it uncertain for some time whether they were animals or vegetables—on which account they were called zoophytes, or animal plants. They were devoid of several of the senses, and the powers of locomotion, and lived and died, and left their remains in the places where they were generated. As they participated so slightly of animal life, they are not noticed in the history of the creation by Moses. And it would not be supposed that they were thought of, but for the attribute affixed to the animals which were created upon the fifth day, which were called moving animals, to distinguish them from those which were not moving.

The third geological epoch occupied the time when the secondary rocks were formed. The same causes which produced the transition rocks were still operating beneath the ocean. The continuance of submarine volcanos, the collision of rocks against each other, by which they were pulverized to atoms, the successive accumulation of new fragments from the breaking up of the former crust, and the deposition of animal remnants, furnished materials

for additional formations; and the secondary rocks were spread out to a great extent upon the primary series.

Before this period, dry land, if it existed at all, was extremely rare. At first it presented itself in small patches, which scarcely deserved the name, in the form of swamps, bogs and morasses. Now it was spread out in greater abundance, in the form of islands of greater or less extent. Although the shocks and convulsions which the earth, in its former rude state was destined to endure, were more sudden and instantaneous than now, yet an age and sometimes a number of ages would elapse, before any perceptible alteration took place. During the second and third periods, when the crust was comparatively superficial, and not deep enough to be lifted above the ocean, eruptions, dislocation, tilting of the lower beds, and upheaving of enormous blocks, occurred oftener than they did afterwards; but the islands which they composed were not so large, and continents, if they were produced at all, were of short duration.

By attending to these things, we can see how the world was created, and how the different stages it has existed in developed themselves. Earthquakes and volcanoes, and the bursting forth of flame from the midst of the ocean, naturally create dread; but they are the most useful of any of nature's phenomena. They are the machinery by which she operates—the instruments by which the ponderous rocks and extended formations were brought into existence. At first, the crude materials, by the breaking up of the former foundations, were furnished; then by rushing against each other, they were crumbled to pieces; and by settling to the lowest places of the ocean, and continuing there for a long time, they were cemented and connected just as we behold them scattered or spread out upon the earth's uneven surface.

The secondary formations comprehend all the series of rocks found between the transition and tertiary classes. They consist of vast depositions of sandstone, conglomerate rocks, and numerous beds of limestone, separated by beds of clay and sand. The limestone of these beds is not so useful for architectural purposes, and not so perfectly crystallized, as limestone found among the transition rocks. Rocks of the secondary class exist in considerable abundance over a great portion of the world; and where they are discovered, the soil is said to be productive. Coal, especially that which is good, does not abound in them. Excepting iron, few metallic beds are found in them. Rock salt and gypsum are the most valuable minerals they contain.

The most remarkable animals of these formations are a species of fish and vertebrated animals allied to lizards. One of the latter, the ichthyosaurus, has a head resembling a dolphin. The orbit of the eye is ten inches broad. They have paddles in lieu of feet, and their vertebræ resemble those of the shark.

During the fourth geological epoch, all the different strata known by the appellation tertiary, were formed. From the depth of these formations, the extent of the animal and vegetable petrifactions, and the changes which must have occurred to render such a multiplicity of animals and vegetables extinct, the remains of which are found among these rocks, it is inferred that this was a long period. During this period, dry land was separated from the ocean, to a greater extent than it ever had been before. The earth, however, presented a different and far more gloomy aspect than it does at present. The ocean was more extensive, places now covered with a luxuriant growth of timber, and blooming with verdure, or swarming with population, were then covered with

swamps and morasses. Broad and extensive valleys, through which the most beautiful rivers meander, were then covered by numberless lakes, connected together by short and narrow strips of water, like those upon the northern frontier of the United States.

At the bottom of these lakes, and in places where the former strata had been furrowed out, broken up or carried away, by torrents and inundations, the tertiary formations were composed. In these were deposited layers of sand and clay, gravel and broken fragments of rocks, leaves and stems of trees, and animal remains of every kind deposited in those days; which being cemented and indurated, a class of rocks was formed equal to any of the former. In some places, these formations are more than six hundred feet in depth. Though they compose extensive surfaces in many places, they are not, like some of the previous formations, universal, because the lakes and inland seas where they were deposited were limited. Great changes have taken place in regard to them since they were formed. Successive torrents and overwhelming inundations have carried them away in some places, so that they are not so extensive as formerly. Earthquakes and volcanos have ruptured their foundations, and covered them over in many places, changing the aspect of nature, and leaving it uncertain what were their original dimensions.

To form an idea in what way the tertiary strata were formed, let a person who is travelling by the side of any of the numerous rivers which stretch themselves from the mountains to the ocean, imagine, where he sees two hills or ridges approaching each other, one upon one side of the river and the other upon the other side, that they were formerly united. This obstructed the free course of the water, and rendered the existence of a lake in the be-

sin above a necessary result; and in these basins the rocks of this class were originally composed.

It is curious, while travelling by the sides of rivers, to notice the different banks, and judge of the different height of the lakes, at different periods. It is interesting, likewise, to trace the former channels of the rivers, where, at different periods, and in different circumstances, they occupied different places. It must not, however, be imagined that all these basins were the depositories of tertiary formations. Some presented themselves in so early a state of the world—when dry land existed in such small proportions—that the proper materials could not be supplied. Others, by the breaking away of their barriers, furnishing in this way complete outlets, did not exist long enough to afford sufficient time for the completion of these formations.

Tertiary formations comprise all the regular strata of limestone, marl, clay, sand and sandstone, deposited above the chalk. Having been deposited and composed after the ocean had considerably subsided, and dry land had presented itself, they consist, in a considerable degree, of fresh water formations, or of fresh and salt water strata alternating with each other. If, by the wearing away of the rocky strata above the falls of Niagara, the bottom of Lake Erie should be laid bare—something which, if the world should exist long enough, may be expected in the course of time—a series of tertiary rocks would present themselves, of which the more recent layers, at least, would be fresh water compositions.

We have now taken a very slight glance at the different epochs of the world. They have been called epochs, because the history of the world may very naturally be divided into those periods, and because clearer views of the formation of the world may be communicated, by

speaking of it in this way. It will be perceived that the scripture epochs and the geological epochs do not correspond with each other, or that one scripture epoch does not occupy the same time that one geological epoch occupies. A great part of the first scripture epoch had elapsed before the first geological epoch commenced. The first geological epoch occupied a part only of the first scripture epoch. The second geological epoch occupied part of the first, and very probably the whole of the second scripture epoch. The third geological epoch commenced about the time when the third scripture epoch commenced, and this and the fourth occupied the whole of the other scripture epochs.

The formations which have been mentioned include the whole of the regular rocky formations. There are other formations, however, which might be spoken of. The basaltic and volcanic rocks form a considerable class; but these were composed in every age of the world, and therefore cannot be called a regular formation. The metallic substances might be considered another formation, and coal another. Besides these, the diluvial and alluvial formation is a very important one, and might be considered regular; but not a regular *rocky* formation. This was formed by the operation of the ocean, air, temperature, and other causes, upon all the other formations; breaking them to pieces, and crumbling them to atoms, rendering the earth a fit place for the production of animals and vegetables, which otherwise could not exist. All the different regular rocky formations, excepting the primitive, were composed of materials similar to those which compose the diluvial and alluvial formations of the present day. By the attrition of the ocean, the collision of rocks against each other, chemical effects of the atmosphere, temperature, and other causes, rocks have been

broken down, and converted into diluvium and alluvium; and from being deposited at the bottom of the ocean and other bodies of water, until they should become indurated and consolidated, they formed rocks again. If all the diluvial and alluvial matter upon the earth at the present day should become consolidated, it would form a series of rocks similar to the other formations, which might be called quaternary. Former rocks, from a variety of causes, are continually being broken down into loose soil, and loose soil is continually changing into rock. From what has been stated, something may be learned in regard to the way in which the earth was formed, and in what way it will be resolved back into its original chaos.

It was stated that there were forms more subtle and ethereal, bestowed on matter, than any which have been discussed. Light, electricity and caloric are some of these. It has been doubted by some, whether light was in reality matter, or a property of matter, belonging to and emanating from some other body. That it is in reality matter, may be inferred from several things belonging to it. To give a clearer view of the subject, it may not be amiss to recapitulate a few things that have been mentioned.

Matter, then, exists everywhere—pervades all space. It is of different degrees of solidity, ponderosity, fusibility and tenuity. The heaviest portions of it gravitate to the lowest and most central places. Earths, metals, &c., either separate or combined, are the heaviest parts of matter; but some of these are heavier than others. Next to these is water, and liquid substances in general; but there are some exceptions, for chalk is lighter than mercury. Aeriform bodies are lighter than liquids; but there is a difference in the specific gravity of these. In general, the heaviest bodies are the most solid ones; but there

are several exceptions. Air occupies the same situation, in regard to water and liquid substances in general, that the latter do to solid substances. To reason from analogy, some body occupying the same situation in regard to air that air does in regard to liquids, may be supposed to exist. Light, without doubt, is this body. To impart clearer views of the subject, we will resort to numbers, to show the relation of different bodies to each other. Solid bodies may be set down at 10, liquids at 100, aeriform ones at 1,000, and light at 1,000,000. This is put down in regard to their different degrees of density and ponderosity; and though it may not be the exact ratio between them, or that they bear to each other, it is an approximation towards it. Solid bodies are placed in a mass at ten rather than one, because there are various degrees of ponderosity belonging to them as individuals.

Caloric, or heat, is a substance bearing the same resemblance to light, no doubt, that silver does to gold, water to quicksilver, and oxygen to hydrogen. Some might indeed doubt of its being a substance; but it is endowed with so many important properties, that something more than mere shadow ought to be allowed it. Were it not for caloric, there might as well be nothing else; and possibly there would not or could not be anything else. The presence of heat has the property of expanding substances, and of rendering them invisible. Perhaps the absence of it, as it condenses them into so small dimensions, would even condense them into nothing. The most remarkable property of heat is to expand substances, and that of its absence to condense them. Everything in nature, even the atmosphere and light, would be condensed into solid substances, were it not for heat.

Heat, then, to a proper extent, is necessary, to endow matter with its essential attributes—to render some por-

tions of it solid, some liquid, some aeriform, and some more ethereal than air. In order to do this, it must exist in separate and distinct bodies; and it must be diffused throughout unbounded space. As separate bodies, it exists at the sun, in the fixed stars, and at the centre of the earth. In its diffused state, it exists to a considerable degree in a latent and insensible form, combined with something else. Heat keeps up a sort of life and motion in solid matter, gives fluidity to water and many other substances in a common temperature, converts a portion of liquid substances into aeriform matter, and a portion of the latter into light.

This is a new subject, and the reader must not be disappointed, if the writer should fail to exhibit it clearly to his understanding. It is difficult to confer visibility on things which are invisible, and tangibility on that which is not tangible. Light has been considered so ethereal and attenuated, that it has not been discussed enough to bring into use words applicable to its properties and susceptibilities. To give an idea of it, therefore, we must compare it with something more known, to which it bears resemblance. Air is the most like it of anything with which it would be proper to compare it. Air is invisible, and so is light. The latter, though invisible, is the proper medium through which other bodies are rendered perceptible to the organs of vision. Air is susceptible of vast expansion, and so is light. In many of its qualities, light, as stated before, may be set down at 1,000,000, when air is set down at 1,000. Some of the resemblances of light to air are not so perceptible, at first thought, as they are after a little reflection. It would not be thought, at first, that light was endowed with specific gravity; but that this is the case is perceptible from the circumstance of its existing in greater abundance in the vicinity of the body

which produces it. As air is most dense where it comes in immediate contact with the body towards which it gravitates, which is the earth, so is light the most abundant near the body which produces it, as the sun, &c. This single circumstance renders it quite probable that it is ponderable. It settles down towards the body which produces it, as air and water do around the earth. Some things, however, are hardly susceptible of being explained upon this principle. If it is ponderable, like air and water, why should it not flow round an object, as air does round a mountain, water round an island, &c. Perhaps this is a property that ought to belong to it, to distinguish it from all other things. Perhaps, too, there are other bodies to prevent this, of which we have no perception. Light passes off in direct lines, in every direction, with such celerity that it may not have the power to pass round anything, where there is the least possible resistance. Even a substance as attenuated as electricity might prevent this. Besides, the propensity of light to be reflected may in part prevent it. One thing here suggests itself, in proof of its being a ponderable substance, which was not mentioned before. What I refer to is its susceptibility of being reflected. Is not what is called reflection the same that is called elasticity in other bodies? Light passes off from the object which produces it with such incomparable celerity, that when it strikes an object which impedes it, it bounds back, like a ball which strikes the floor or the ground. Polished surfaces, where it cannot be lost among the interstices, send more of it back than rough ones. If it were not a ponderable substance, this would not take place. If the principles here laid down be correct, it may be asked, how light passes through air. Air, however, being endowed with transparency, may possess facilities in regard to this which,

though they cannot be explained in our present unenlightened state on this subject, may admit of an explanation when it shall be more attended to. Another thing may be brought into the account, likewise. As a million of particles of light exist where there is a single particle of air, the former may pass around and between the latter, as men pass round and between houses, the satellites of planets around their primaries, and the primaries around those which are centres or pivots for the whole to revolve around.

Heat or caloric is a substance which, on account of its diffusibility, may be compared to light; and which resembles light more than either light or heat does air, or any other substance which has been named. It is considered to be a substance, both from its perceptibility to at least one of the senses, and its effects upon other bodies. Combined with other bodies, it greatly changes their nature. It changes them, too, in proportion to its intensity. A little heat only changes the temperature of a body; more converts a solid body into a liquid; more still, the liquid into an aeriform one; and still more, the whole into light. A little heat will cause steam or aeriform matter to proceed from other bodies, but it requires heat sufficient to produce combustion, to cause light to proceed from them.

Now while groping in the realms of conjecture, or soaring upon the wings of imagination, it will perhaps subject us to no more censure, not to say pity, to usher forth some further wild theories. Is there not more analogy between earthquakes and volcanos, thunder and lightning, and the aurora borealis, than is generally supposed? This is only introduced as a query, without seriously entering into the belief of such a suggestion. What I mean by this analogy is, earthquakes and volcanos may have a similar effect upon the solid and liquid substances

of the earth, to that of thunder and lightning upon aeriform substances, and the latter may have a similar effect upon aeriform bodies, to that of the aurora borealis upon the more attenuated substance, light. Nature abounds in resemblances. There is a regular and almost imperceptible gradation in everything. There is a chain that passes between one thing and another, from nothing up to things of the greatest magnitude. One thing puts another in motion, and this another, ad infinitum. The laws of nature are simple, but they are extensive. They ramify through everything, but they are all consistent with each other.

LIFE SPAR.

The real value of any article of commerce depends in a measure upon the benefit which it confers upon mankind. For instance, rice, an article raised in superabundance in climates where it is an indigenous plant, bears, in all parts of the world, a price commensurate with the benefit which its consumers derive from it;—so also with wheat, corn, &c., the prices of which vary, according to the greater or less amount which may be produced in the year by the growers. The question of utility can be solved in reference to any article, by considering the real benefit or profit which men derive from it.

Within a few years, India Rubber has been employed for almost every variety of purposes. From being only used in erasing the pencil marks made by some drawing master or his pupils, it has run through almost the whole catalogue of domestic uses, until it has become a medium of *light*, and, if our genius do not desert us, will supersede all farther use of *paper*.

The various companies which have been organized for the manufacture of India Rubber, some of which have succeeded, have produced no article which promises more universal benefit than the Life Spar, recently invented by J. S. Armstrong, the enterprising agent of the Roxbury India Rubber Company. The consideration of the many serious accidents which have happened in consequence of the burning of steamboats, and in particular, the truly awful instance of the Royal Tar, which is still fresh in

our memories, has induced him to offer to the public the Life Spar, of which we will attempt a description.

It consists of a long cylinder, fourteen feet and a half in length, and thirty-six inches in circumference, made of the strongest twine duck on its exterior, and lined with cotton drilling. The cloth, before making up, receives a coat of India rubber, which renders it perfectly air-tight. Two bands run from either end along its whole length, to which are attached twenty-four rings, of sufficient calibre to receive the arm of any individual who may be incapable of holding on with his hand. It is inflated with air by three tubes, one at each end, and one in the centre. Its weight, when inflated, is twenty pounds. It is capable of supporting thirty men in the water, although there are rings for only twenty-four. It may be packed with ease in the top of a common sized travelling trunk. In case of accident on board a ship or steamboat, this article can be inflated in fifteen minutes by the breath of three men, or in less than half that time by the common valve bellows; and, being thown overboard, will afford almost perfect security to those who will entrust themselves to it.

There have been many inventions for this purpose, but none which answers the end so admirably. It is portable, and occupies but little space. Every steamboat on our waters should be supplied with it; and no ship-master or owner is justified, when the expense is so small, in suffering his vessel to leave port without one. They are for sale at the Roxbury India Rubber Company's store, No. 82 Washington Street. G. T. D.